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THESIS

AN ANALYSIS OF THE ORDNANCE OFFLOAD/ONLOAD COSTS OF PACIFIC FLEET LARGE DECK AMPHIBIOUS ASSAULT SHIPS (LHA AND LHD) HOMEPORTED IN SAN DIEGO

by

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December, 1995

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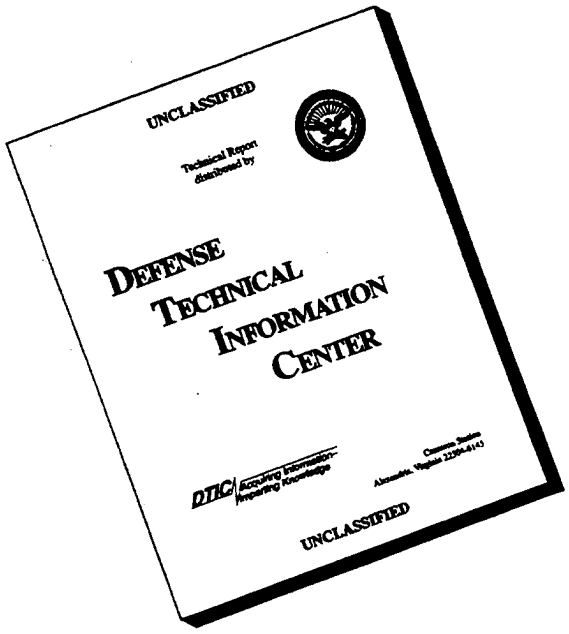

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This thesis uses total cost and external safety considerations to determine the most cost effective and safest method of embarking/debarking ordnance to support the Pacific Fleet. The study relies on historical data and spreadsheet-based Monte Carlo simulations to estimate operation times. Simulation is required because few operations have been conducted so historical data is limited. The "add-in" package, "Crystal Ball," applies stochastic simulations to decision making analysis. The actual costs of anchorage and vertical replenishment (vertrep) operations are compared, using triangular and uniform distribution models. This thesis provides a more accurate cost analysis for comparing onload/offload vertrep and anchorage operations. The finding from this comparison determined that vertreps provide the largest benefit to the fleet in terms of cost, training, and flexibility.

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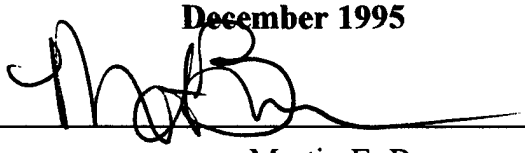
Author: 
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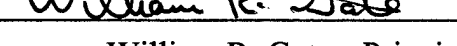
Approved by: 
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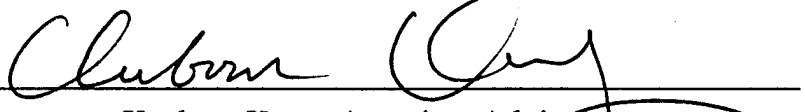
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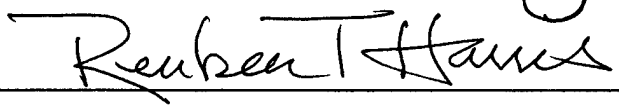
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ABSTRACT

This thesis uses total cost and external safety considerations to determine the most cost effective and safest method of embarking/debarking ordnance to support the Pacific Fleet. The study relies on historical data and spreadsheet-based Monte Carlo simulations to estimate operation times. Simulation is required because few operations have been conducted so historical data is limited. The "add-in" package, "Crystal Ball," applies stochastic simulations to decision making analysis. The actual costs of anchorage and vertical replenishment (vertrep) operations are compared, using triangular and uniform distribution models. This thesis provides a more accurate cost analysis for comparing onload/offload vertrep and anchorage operations. The finding from this comparison determined that vertreps provide the largest benefit to the fleet in terms of cost, training, and flexibility.

TABLE OF CONTENTS

I. INTRODUCTION 1
- A. BACKGROUND 1
- B. RESEARCH TOPIC 1
- C. RESEARCH QUESTIONS 2
- D. RESEARCH REVIEW 2
- E. METHODOLOGY 2
- F. THESIS CONSTRAINTS 3

II. ANCHORAGE OPERATIONS, SEAL BEACH 5
- A. BACKGROUND 5
- B. ASSUMPTIONS 5
- C. ONLOAD AND OFFLOAD OPERATIONS 6
- D. PROCESS OPERATIONS FOR AN ANCHORAGE ONLOAD 6
- E. PROCESS OPERATIONS FOR AN ANCHORAGE OFFLOAD 7
- F. BENEFITS 9
- G. COST ANALYSIS FOR ONLOAD OPERATIONS 9
  - 1. Preparation Costs 10
  - 2. Travel And Setup Time 11
  - 3. Double Handled Material 12
  - 4. Transportation Costs, Fallbrook to Seal Beach 14
  - 5. Detained Truck Costs 15
  - 6. Intrastation Rail Costs 16
  - 7. Barge, Ship and Crane Support Costs 17
  - 8. Tug Support 18
- H. COST ANALYSIS FOR OFFLOAD OPERATIONS 19
  - 1. Tug Support 19
  - 2. Barge, Ship and Crane Support Costs 20
  - 3. Onload Conveyance at the Wharf 20
  - 4. Segregation Costs 21
  - 5. Transfer to Magazine/Marshaling Area Costs 22
  - 6. Transportation Costs Interstation, Seal Beach to Fallbrook 22
  - 7. Transfer Depot and Transport Intrastation Costs, Fallbrook . . . 23
- I. SUMMARY OF ANCHORAGE OPERATION COSTS 24

III. VERTICAL REPLENISHMENT OPERATIONS, FALLBROOK 25
- A. BACKGROUND 25
- B. ASSUMPTIONS 25
- C. ONLOAD AND OFFLOAD OPERATIONS 26
- D. PROCESS OPERATIONS FOR A VERTREP ONLOAD 26
- E. PROCESS OPERATIONS FOR A VERTREP OFFLOAD 27
- F. BENEFITS 28

G. COST ANALYSIS FOR ONLOAD OPERATIONS 28
1. Preparation and Travel And Setup Costs 29
2. Double Handled Material 30
3. Transportation Costs, Seal Beach to Fallbrook 30
4. Transfer Depot Costs 31
5. Intrastation Transportation Costs, Fallbrook 32
6. Intrastation Conveyance Costs to Helicopter Pad 33
7. Helicopter Operation and Support Costs 33
H. COST ANALYSIS FOR OFFLOAD OPERATIONS 35
1. Helicopter Operation and Support Costs 35
2. Intrastation Transportation Costs, Fallbrook 36
3. Conveyance Costs to Segregation 37
4. Segregation Costs from Transfer to Reloading Conveyance 37
5. Transfer to Magazine from Helicopter Pad 38
6. Transfer to Magazine from Segregation 39
I. SUMMARY OF VERTREP OPERATION COSTS 39

IV. DISCUSSION OF ACTUAL COSTS 41
A. MODEL DEVELOPMENT 41
B. STANDARD LHA LOAD DEVELOPMENT 41
C. UNIFORM DISTRIBUTION MODEL 44
1. Number of Pallets per Operation 44
2. Summary of Uniform Distribution Model Scenarios 44
D. TRIANGULAR DISTRIBUTION MODEL 45
1. Listing of Variables 45
2. Summary of Triangular Distribution Model Scenarios 45
E. COMPARISON OF OPERATION COSTS 46

V. DISCUSSION OF EXTERNAL COSTS 49
A. ORDNANCE SAFETY 49
B. SEAL BEACH, SAFETY ISSUES 50
1. The Magazine Storage Areas 50
2. The Wharf Operating Area 50
3. The Ordnance Anchorage Areas 51
4. Stakeholder Analysis in a Maximum Explosive Accident 52
C. FALLBROOK, SAFETY ISSUES 54
1. The Magazine Storage Areas 54
2. The Transportation Routes and Handling 55
3. Helicopter Operations at the CAL Site 55
4. Stakeholder Analysis in a Maximum Explosive Accident 56
D. ORDNANCE SECURITY 58
1. Seal Beach Anchorage Operations 58
2. Fallbrook (Camp Pendleton) Vertrep Operations 59

VI. SUMMARY AND RECOMMENDATIONS 61
A. THE BENEFITS AND COSTS ASSOCIATED BY OPERATION ... 61
B. THESIS SHORTFALLS 62
C. RECOMMENDATIONS 63

APPENDIX A. ONLOAD ANCHORAGE MODEL 65

APPENDIX B. OFFLOAD ANCHORAGE MODEL 71

APPENDIX C. ONLOAD VERTREP MODEL 77

APPENDIX D. OFFLOAD VERTREP MODEL 83

APPENDIX E. UNIFORM DISTRIBUTION MODEL 89

APPENDIX F. TRIANGULAR DISTRIBUTION MODEL 105

LIST OF REFERENCES 121

INITIAL DISTRIBUTION LIST 123

I. INTRODUCTION

A. BACKGROUND

Historically, large decked amphibious ships homeported in San Diego have embarked/debarked their ordnance using anchorage operations at Naval Weapons Station, Seal Beach (Seal Beach). Their large unique configuration and the required explosive safety quantity distance (ESQD) prevented wharf (pierside) operations anywhere but north of Seattle at Port Hadlock. In 1990, Naval Ordnance Center, Pacific Division, Fallbrook Detachment (Fallbrook) pioneered the use of helicopters in vertical replenishment (vertrep) for ordnance onload and offloads. The success of the program led COMMNAVSURFPAC to release a message stating that, "starting October 1992, all ships would be serviced via the vertrep procedure" (Smith, 1992). In response, both the wharf and vertrep procedural costs were broken down and compared. This comparison was based on a total cost level per site, and specific costs for Seal Beach and Fallbrook's Requisition, Segregation, Storage and Issue (RSS&I) cost.

During the study, conducted in May of 1992, vertrep operations proved economical for large decked amphibious ships. The ability to supply ordnance to a ship homeported in San Diego, off the shore of Camp Pendleton (71 miles north of San Diego) has created more flexibility for the Pacific Fleet in time and steaming costs.

The increasing encroachment of suburban and commercial development towards ordnance sites, increasing congestion along the southern California highways and the closure of bases along the pacific coast, specifically Long Beach Naval Shipyard, has had an impact on the fleet's budget. Forced by these budget constraints and the political environment where the bases are located, care must be exercised to maintain high fleet readiness while minimizing public access to hazardous situations. This thesis will provide a tool for investigating costs within a micro-economic framework to maximize fleet readiness with minimal costs (actual and external).

B. RESEARCH TOPIC

This thesis provides a tool for examining actual and external costs to support decisions regarding the most cost effective and safest method of embarking/debarking ordnance to support the pacific fleet. This study will focus on two classes of ships, the LHA 1 (Tawara) and LHD (Wasp) classes and operations in two specific locations (anchorage in Seal Beach and vertreps off Camp Pendleton). This study is divided into two major parts:

The first part consists of a case study of actual costs for anchorage and vertrep operations.

The second part incorporates external costs and performs the operations' cost benefit analysis.

The study relies on historical data and spreadsheet-based Monte Carlo simulations to represent operation times, since few operations have been conducted.

C. RESEARCH QUESTIONS

1. The primary questions are:

- What are the benefits and costs associated with each operation?
- What are the operation's marginal costs?

2. Subsidiary research questions will address the effects of the following factors:

- What are the transportation costs associated with each operation?
- What is the time element associated with each operation?
- What are the safety factors associated with each operation?
- What are the security considerations associated with each operation?
- What are the effects on fleet readiness associated with each operation?

D. RESEARCH REVIEW

The primary sources of data collection include records of previous operations, including cost comparisons obtained from interviews with ordnance personnel at Fallbrook and Seal Beach, and observational procedures during an anchorage operation conducted in September, 1995. This information is incorporated into models to emulate varying ordnance onloads and offloads. The cost and time studies are then developed into spreadsheet form to enhance the reader's understanding of the cost comparisons.

E. METHODOLOGY

The 1992 study conducted for the RSS&I Program Manager produced a model using full onloads and offloads for the amphibious ships. The model generated its cost information from various sources including: "... labor standards, transportation cost data, standard load lists, observing operations and by interviewing key personnel" (Smith, 1992).

The models developed in the cost study discussed six options for the ships serviced by Fallbrook and Seal Beach. Limiting the scope to anchorage and vertrep operations eliminated two options (wharf operations) from the scenarios. Other options developed in the study include segregating ordnance offloaded via vertrep by establishing a segregation facility at Fallbrook or transporting the ordnance to Seal Beach for segregation.

Limitations in the cost study were identified when reviewing the allocations for material, man-power, and equipment. The cost study approached the indirect costs (man-power and equipment) based on "days of evolution" and man-power per ton. A "day of evolution" treats the operation as being charged for a standard 8 hour work day (which includes breaks, lunch periods, etc.), whether the actual operation time is actually longer or shorter than the time charged. The study indicated that direct labor time could not be accurately allocated to an actual process (e.g. time per pallet).

The allocation of transportation costs include both on-station and off-station material movement. Costs were compiled using Public Works, Marine Corps transportation, and the cost of commercial trucking between Fallbrook and Seal Beach (Smith, 1992).

> The percentage of material from each site for the onload procedure is based on information gathered from the Okinawa and Tarawa onloads. The number of pallets were derived from the daily shipments list, which included the number of commercial trucks and the document numbers of the material on each. The document provided the total number of pallets transported. (Smith, 1992)

F. THESIS CONSTRAINTS

Anchorage and vertrep ordnance operations occur infrequently making it difficult to discern information needed for this study. Vertrep operations have averaged eleven per year, while the last anchorage operation in Seal Beach was in 1990. The information used to determine costs in a 1991 study comparing the two types of operations included cranes and tugs that were available through the Long Beach Naval Shipyard. After the naval shipyard closed during the Base Realignment and Closure (BRAC) process, one of the cranes was shipped to Panama; the other is due to be sent to another shipyard. This leaves Seal Beach with a higher cost to rent equipment. Other costs that have changed since the 1991 study include the deteriorating infrastructure of equipment (Seal Beach's barges and the fleet's CH-46 helicopters), and an increase in the RSS&I rate for operations (from $54.96 per man-hour to a current cost of $101.93 per man-hour).

The final step in cost comparisons is verifying the cost data through observation. Verification of this study could not be certified because of constraints in time, limited operational opportunities, and limited access to cost data in both the original cost study and this thesis.

The organization of the thesis is organized as follows:

Chapter	Title/Description
I.	INTRODUCTION. The mission of the pacific ordnance centers, the evolution of ordnance operations, the changing environment for base operations, and the methodology of the study.

Chapter	Title/Description
II.	ANCHORAGE OPERATIONS, SEAL BEACH. The background of ordnance operations at Seal Beach, description of anchorage operations and development of the model costs based on historical analysis, actual costs and anticipated ordnance requirements.
III.	VERTREP OPERATIONS, FALLBROOK. The background of ordnance operations at Fallbrook, description of vertrep operations and development of the model costs based on historical analysis, actual costs and anticipated ordnance requirements.
IV.	DISCUSSION OF ACTUAL COSTS. Actual costs are defined as those costs directly attributable to transportation, handling, and equipment. A comparison of the developed costs discussed earlier, using "Crystal Ball", spreadsheet simulation program to enhance the reliability of the estimates in time and cost.
V.	DISCUSSION OF EXTERNAL COSTS. External costs are defined as those costs that are not directly attributed. A comparison of costs in terms of trade-offs using micro-economic analysis.
VI.	SUMMARY AND RECOMMENDATIONS. The evaluation of actual costs in terms of future capability, ability to support fleet requirements, and the cost effectiveness of maintaining the status quo.

II. ANCHORAGE OPERATIONS, SEAL BEACH

This chapter presents background of ordnance operations at Naval Weapons Station, Seal Beach, describes anchorage onload and offload operations and develops the model costs based on historical analysis, actual costs and anticipated ordnance requirements. Additionally, the chapter explains how the costs are derived, and summarizes the costs associated with each anchorage operation.

A. BACKGROUND

Naval Weapons Station, Seal Beach (Seal Beach) is located 135 miles north of San Diego (North Island). Seal Beach is also home to the Naval Ordnance Center, Pacific Division (NOCPacDiv), which is responsible for supplying and coordinating all ordnance material for the Pacific Fleet. Supporting this mission NOCPacDiv is responsible for over 772 magazines while utilizing 2,685,658 square feet of storage. Seal Beach is responsible for 144 magazines using 782,065 square feet of NOCPacDiv's total. (NOCPacDiv Planning Dept, 1995)

B. ASSUMPTIONS

Some assumptions concerning operations at Seal Beach were made during the 1992 cost study and will be used in this thesis. This is to provide the most accurate and consistent cost data.

1. One package of landing force operational reserve material (LFORM), equal to 15 Days of Ammunition (DOA), is stored at Seal Beach (Smith, 1992). The requirement by ship type is 5 DOA for an LPD and 10 DOA for an LHA/LHD and the soon to be decommissioned LPH "USS New Orleans."

2. "The actual hours are used rather than historical man-hours per ton rates for all processes with the exception of segregation" (Smith, 1992).

3. Equipment is allocated as a direct cost.

4. All partially loaded transportation costs (barge and commercial carrier) are equivalent to fully loaded commercial conveyances.

5. Naval Special Warfare Material, Seal Team, Underwater Demolition Team (UDT) category NALC/DODICs are included in an Explosive Ordnance Disposal Mobile Unit (EODMU). (Smith, 1992)

6. The processing time for Seal Beach and Fallbrook are equivalent. (Smith, 1992)

C. ONLOAD AND OFFLOAD OPERATIONS

The days of evolution for both wharf and anchorage operations were taken from management information within the planning section of the Ordnance Department. LPD, LPH, and LKA class ships are scheduled for three "days of evolution"; LHA class ships are scheduled for an eight day evolution. The eight days include four days of pre-loading barges, and four days for loading the ship. (Smith, 1992)

The material quantities used for this analysis are based on information from three sources; standard load lists, actual load lists, and management information. The combination of these sources allows for the most accurate information relating to material quantities (Smith, 1992).

D. PROCESS OPERATIONS FOR AN ANCHORAGE ONLOAD

The process flow and allocable costs for an anchorage operation were determined through observation and interviews conducted during the 1992 cost study. They consist of:

- Preparation of material, Seal Beach
- Preparation of material, Fallbrook
- Preparation travel and setup, Seal Beach
- Preparation travel and setup, Fallbrook
- Material requiring double handling - travel and handling, Fallbrook
- Material requiring double handling - travel and handling, Seal Beach
- Schedule commercial trucks, Fallbrook
- Load ordnance material, Fallbrook
- Transport material intrastation, Fallbrook
- Transport material to Seal Beach
- Transport to interchange yard (detention costs)
- Load railcar (offloading of commercial conveyance included)
- Transport to the wharf

- Offload conveyance at the wharf
- Load equipment/personnel on the barge(s)
- Load ordnance on the barge(s)
- Schedule and lease floating crane support
- Schedule other station personnel support
- Schedule and lease tug support
- Transport barge with equipment and personnel to anchorage
- Load ship
- Download retrograde (ordnance, equipment, and personnel)
- Transport barge(s) with equipment and personnel to the wharf

E. PROCESS OPERATIONS FOR AN ANCHORAGE OFFLOAD

Similarly, the process flow for an anchorage offload operation was determined through observation and interviews conducted during the 1992 cost study. A major difference between onload and offload operations is the inability of the planners to accurately know the condition of the retrograde material and be able to control its retrograde by type. The process for an offload is provided below.

- Schedule and lease floating crane support
- Schedule other station personnel
- Schedule and lease tug support
- Load equipment onto the barge(s)
- Transport equipment/personnel to the anchorage
- Offload the ship to the barge(s)
- Transport barges to the wharf
- Load conveyance (rail and station's trucks)

- Transport to segregation (Seal Beach)
- Receipt at segregation (Seal Beach)
- Segregate
- Load conveyance (rail)
- Transport to magazine from segregation (Seal Beach)
- Receipt at magazine (Seal Beach)
- Transport to Seal Beach magazine/marshaling yard from wharf
- Receipt at Seal Beach magazine
- Schedule commercial trucks
- Transfer material to commercial truck (direct to Fallbrook)
- Transport to Fallbrook
- Receipt at Fallbrook transfer depot
- Load conveyance transfer depot (Fallbrook)
- Transport to magazine(s)
- Offload material to Fallbrook magazine
- Code E (rework material) transported to Fallbrook
- Receipt at Fallbrook transfer depot
- Load conveyance transfer depot (code E)
- Transport material to Fallbrook magazine
- Offload material at Fallbrook magazine

F. BENEFITS

The strength of NWS Seal Beach is its close proximity to San Diego, Camp Pendleton and the fleet located at North Island. By conducting ordnance onload and offload operations through a combination of pierside and anchorage operations, Seal Beach serves all the Pacific Fleet's Amphibious Ships.

G. COST ANALYSIS FOR ONLOAD OPERATIONS

Table 2.1 provides an overview of the percentage of ordnance material maintained at Seal Beach and that was received from Fallbrook. LFORM not maintained at Seal Beach (15 DOA) is shipped from Fallbrook, which accounts for approximately 82.5% of all LFORM. Based on the data provided from the 1992 cost study, Seal Beach receives approximately 80% of its LFORM (except class/division 1.2(18)) and 90% of its LFORM class/division 1.2(18) ordnance from Fallbrook. This provides a cost unique to Seal Beach in transportation, preparation, and double handling for anchorage operations (offloading a truck into storage and loading a boxcar for the operation).

A total of 1,212 pallets was used as a base for a LHA onload during the 1992 cost study. A breakdown of this information is provided in Table 2.1.

Material Type	Total Pallets	Percent From S.B.	Pallets From S.B.	Pallets From Fallbrook
LFORM	615	20%	123	492
LFORM - 1.2(18)	195	10%	20	176
SHIP'S FILL	80	100%	80	0
EODMU	25	100%	25	0
MISSION ALLOW.	297	100%	297	0
TOTAL PALLETS	**1,212**		**545**	**668**

Table 2.1 Breakdown of Pallets by Station for an LHA Anchorage Operation
From Ref (Smith, 1992)

1. Preparation Costs

LFORM has been divided into two categories, LFORM and LFORM class/ division 1.2 (category 1800). The unique explosive safety hazards for LFORM class/division 1.2 (18) requires separate and special handling, which is why it has been identified separately. The cost for preparing LFORM includes the following:

- Loading/unloading of boxes or pallets
- Scanning a box/pallet
- Making/placing opscan labels
- Filling out/placing shipping labels
- Applying banding
- Locating material
- Digging out/returning material
- Filling out/placing condition code tags
- Cutting/spraying stencils
- Situating pallets correctly

The 1992 cost study used a RSS&I rate of $54.95 per man-hour. The rate is established by the Comptroller of the Naval Ordnance Center (NOC), Indian Head, Maryland based on the combined overhead costs for all Naval Ordnance Activities. The current rate per man-hour is $101.93, which is the rate for services provided at all Naval Ordnance Activities. Unfortunately the reimbursable rate is all encompassing and not adjusted for station efficiency nor even location.

Preparation Costs attributed to an anchorage onload operation consist of the number of pallets times the estimated hours per pallet times the crew size times the standardized rate. The preparation time varies by type of material but is the same for all stations. Table 2.2, Preparation Costs (Anchorage Onload) provides an overview of the cost for each station by material.

Material Type	Est. Hrs./ Plt. Prep	Prep Cost Seal Beach	Prep Cost Fallbrook	Trvl & Setup Seal Beach	Trvl & Setup Fallbrook
LFORM	.22	$5,516.45	$22,065.81	$1,002.99	$6,268.70
LFORM - 1.2 (18)	.22	$896.98	$7,893.46	$163.09	$2,242.46
SHIP'S FILL	.27	$4,403.38	$0.00	$652.35	$0.00
EODMU	.32	$1,630.88	$0.00	$203.86	$0.00
MISSION ALLOW.	.27	$16,347.53	$0.00	$2,421.86	$0.00
TOTAL COST		**$28,795.23**	**$29,959.27**	**$4,444.15**	**$8,511.16**

Table 2.2 Preparation Costs (Anchorage Onload)

2. Travel And Setup Time

The travel and setup time is the time it takes a crew to travel to a magazine and setup for the process which they are to perform. The times are taken from the 1992 cost study which were developed from times in the APS system. The actions included in these times are:

- Opening/closing the magazine door
- Blocking and Bracing (B&B) time
- Quality Assurance/Inspection (QA/QI)
- Ordering spacers and fillers
- Retrieving/placing/removing deckplate
- Retrieving empty pallets
- Retrieving/returning forklift
- Cutting banding
- Measuring pallets

- Calculating cube and weight

- Checking Technical Weapons Order (TWO) (manuals providing class/division, weight, and cube)

- Checking Notice of Ammunition Reclassifications (NARS) (notice of recalled or superseded ammunition)

- Checking Department of Transportation (DOT)/United Nations (UN) markings (safety regulations for segregation and handling)

- Filling out paperwork

The travel and setup time is derived from the number of pallets divided by the average number of pallets per magazine per trip. That number is then multiplied by the estimated hours per trip, the size of the crew, and the standardized RSS&I rate. The number of pallets used per magazine per trip for Seal Beach is 10 and for Fallbrook 8. Fallbrook's larger size requires more time to reach the magazine areas. To adjust for this longer traveling distance, the 1992 study uses .4 travel time per pallet for Seal Beach and .5 for Fallbrook.

3. Double Handled Material

Double handled material refers to ordnance that has to be loaded onto a vehicle and offloaded in another area to be segregated, built, or otherwise worked on due to safety or space considerations. This material is then "reloaded" onto another vehicle for shipment from the working area. The percentage for double handled material received from Fallbrook in the 1992 study was 65%. The authors (Smith and Rahman) noted that the high percentage of ordnance requiring double handling resulted from three factors. First, the majority of ordnance retrograded was used in Desert Storm. As the material is used, the requirement for repalletization is reduced. Second, a large number of magazines at Fallbrook lack adequate dock space (six foot docks) to safely perform a preparation procedure. Fallbrook is aggressively working its magazine storage load plan to better utilize its dock space. Finally, a certain percentage of pallets will always require double handling due to the equipment and materials required to complete the procedure.

The percentage of material double handled in the prep process for an onload operation is included to show the costs associated with moving material to a location other than the magazine in which it is stored in order to prep it. Included are:

- The costs of loading the material at the magazine

- Transporting it to another location

- Offloading at the second location
- Reloading the material at the second location
- Transporting it back to a magazine
- Offloading it at the magazine (Smith, 1992).

The reduction in "Desert Storm" material and restructuring Fallbrook's load plan makes 35% an appropriate ratio for double handled material. Other variables used in establishing double handling costs are:

1. A crew size of three (includes the driver),
2. Vehicles carry an average of 10 pallets per tractor trailer, and
3. Travel time of .25 hours with a .05 hour loading time.

Table 2.3 provides an overview of the double handling costs. The double handling costs are based on the percentage of pallets requiring double handling plus the normal number of pallets divided by the number of pallets per truckload. As an example, if 5% of 100 pallets require double handling, the double handling percentage used would be 105% times 100 pallets (105 pallets). For "Travel Costs" the 105 pallets would be divided by the number of pallets per truck (10) for 10.5 truckloads. The number of truckloads are multiplied by the average travel time, the crew size, and the standardized RSS&I rate. The "Load and Unload Costs" uses the same double handling percentage multiplied by the loadtime per pallet (hours), the crew size, and the standardized rate. A complete listing of the computations used to determine the onload costs is provided in Appendix A.

Material Type	Dbl Hnd - Trv Seal Beach	Dbl Hnd - Trv Fallbrook	Dbl Hnd - Ld Seal Beach	Dbl Hnd - Ld Fallbrook
LFORM	$1,328.96	$3,385.10	$1,328.96	$6,770.19
LFORM - 1.2 (18)	$216.09	$1,210.93	$216.09	$2,421.86
SHIP'S FILL	$864.37	$0.00	$864.37	$0.00
EODMU	$270.11	$0.00	$270.11	$0.00

Material Type	Dbl Hnd - Trv Seal Beach	Dbl Hnd - Trv Fallbrook	Dbl Hnd - Ld Seal Beach	Dbl Hnd - Ld Fallbrook
MISSION ALLOW.	$3,208.96	$0.00	$3,208.96	$0.00
TOTAL COST	**$5,888.50**	**$4,596.02**	**$5,888.50**	**$9,192.05**

Table 2.3 Double Handling Costs (Anchorage Onload)

4. Transportation Costs, Fallbrook to Seal Beach

Intrastation conveyance (within Fallbrook) uses vehicles from the station. The cost for these trucks is contained in the RSS&I stabilized rate (Smith, 1992). The other transportation cost is for commercial trucks carrying material interstation (Fallbrook to Seal Beach). The cost study used the costs of commercial conveyance provided by the Seal Beach Traffic Manager. The information for commercial transport from Fallbrook to Seal Beach is:

- Category I and II = $ 970
- Category III and IV = $ 690

Based on the average conveyance and material, a cost of $800 was used by the 1992 cost study. Current costs for transportation could not be provided by the Transportation Officer at Fallbrook so this study also uses an average of $ 800 per truck.

The other transportation costs for conveying of material from Fallbrook to Seal Beach are broken into four components. The first is the "Cost for Scheduling Commercial Trucks" by the traffic management section, Fallbrook. The cost is calculated by the number of trucks multiplied by an average management fee (amount of time per RSS&I rate over time). The number of trucks is determined by the number of pallets divided by the average number of pallets per truck. The number of pallets per commercial truck is twenty (20).

The second process is the "Loading of Conveyance at Fallbrook". This cost originates from the number of pallets multiplied by: the "loadtime with blocking and bracing (B&B)," the crew size with a block and bracer, and the standardized RSS&I rate.

The third process cost is for "Intrastation Costs (Fallbrook) or "travel and setup station transfer costs". This cost is defined by the number of trucks multiplied by: the hours per trip (intrastation), the crew with a block and bracer, and the RSS&I rate.

The final cost for this evolution is the "Travel Interstation Costs (Fallbrook)." This is determined by the number of trucks multiplied by the average cost for commercial trucking. A summary of the station transfer costs is provided in Table 2.4.

Material Type	Sched Cost Comm Trk	Load Convey at Fallbrook	Tvl Intrastation Costs (Fallbrk)	Tvl Interstation Costs (Fallbrk)
LFORM	$1,845.00	$9,026.92	$3,761.22	$19,680.00
LFORM - 1.2 (18)	$660.00	$3,229.14	$1,345.48	$7,040.00
SHIP'S FILL	$0.00	$0.00	$0.00	$0.00
EODMU	$0.00	$0.00	$0.00	$0.00
MISSION ALLOW.	$0.00	$0.00	$0.00	$0.00
TOTAL COST	**$2,505.00**	**$12,256.06**	**$5,106.69**	**$26,720.00**

Table 2.4 Interstation Transfer Costs (Anchorage Onload)

5. Detained Truck Costs

This next section describes a small subsection of the interstation transfer costs for Seal Beach. Material received from Fallbrook (and other ordnance stations) sometimes arrives too late to make it cost effective to unload the commercial truck and load it into either a magazine or a railcar. This cost tradeoff is based on the cost for double handling the material into a railcar or paying a detention charge (truck lease fine) for keeping it loaded on the commercial truck. Based on the estimates in the cost study and the interviews conducted with Seal Beach planners a figure of 95% of material is loaded into the railcars, and 30% of the total trucks are detained (periods may range from overnight to up to three weeks). The detention costs are based on 30% of the detained trucks multiplied by a crew of one (driver), the RSS&I rate.

The number of pallets used for the detained trucks are obtained from the number of pallets multiplied by the percentage (5%) and divided by an average number of pallets per truck (14). The cost of offloading the detained trucks at the wharf is based on the number of detained pallets multiplied by the crew size (forklift), the offload time per pallet (detained truck), and the RSS&I rate. Table 2.4 provides an overview of detained truck charges from the detention yard to offloading the conveyance at the wharf.

Material Type	# of Pallets Detained Trk	Detained Trk Costs (SB)	Trvl (Trk) to Wharf (SB)	Offload Conv Wharf (Trk)
LFORM	31	$752.24	$33.58	$2,664.20
LFORM - 1.2 (18)	10	$269.10	$10.65	$844.74
SHIP'S FILL	4	$0.00	$4.37	$346.56
EODMU	1	$0.00	$1.37	$108.30
MISSION ALLOW.	15	$0.00	$16.22	$1,286.61
TOTAL PLTS/COSTS	**61**	**$1,021.34**	**$66.18**	**$5,250.41**

Table 2.5 Detained Truck Costs (Anchorage Onload)

6. Intrastation Rail Costs

The intrastation costs consist of both the detained truck costs and travel by railcar. The previous section broke down the detained truck costs, this section discusses the railcar costs. The actual cost of running and maintaining a rail system at Seal Beach could not be provided. The cost of the system and its maintenance (overhead) are not broken out for other activities. The cost of the entire rail system infrastructure are rolled into the station costs, which are used to determine the RSS&I rate. Advantages to the rail system are the ability to preload a large number of railcars and prestage them, assisting the planning process and reducing downtime. Additionally, the onload and offload process is expedited by staging most of the load at the wharf. In the 1992 study, the rail costs were not included as a separate figure, primarily because those costs were not charged to RSS&I as a reimbursable service. This thesis treats these costs as reimbursable and directly allocates them to the switch engine crew. This is consistent with the treatment for the public works department.

The number of pallets (railcar) was obtained from the total number of pallets multiplied by the percentage of the pallets loaded aboard the railcars. Table 2.6 provides a breakdown of the intrastation rail costs from the loading of conveyance to the offload at the wharf.

Material Type	# of Pallets Railcar	Load Convey Railcar (SB)	Tvl (Rail) to Wharf (SB)	Offload Conv Wharf (Rail)
LFORM	584	$10,719.47	$2,382.10	$14,888.15
LFORM - 1.2 (18)	185	$3,398.86	$755.30	$4,720.63
SHIP'S FILL	76	$1,394.40	$309.87	$1,936.67
EODMU	24	$435.75	$96.83	$605.21
MISSION ALLOW.	282	$5,176.72	$1,150.38	$7,189.89
TOTAL PLTS/COSTS	**1151**	**$21,125.20**	**$4,694.49**	**$29,340.55**

Table 2.6 Intrastation Rail Costs (Anchorage Onload)

7. Barge, Ship and Crane Support Costs

"Barge and Ship" costs are based on days of evolution. A day of evolution is a "normal" eight hour work day. The planners at Seal Beach estimated the number of days to conduct a full anchorage load for an LHA. The first four days are devoted to preloading the barges. This evolution can be done in a time expanding over four days by distributing the crews and workloads, but is an average of 48 work hours. The next four days are dedicated to the actual ship load operation. This depends on the ship and additional support operations (tug and floating crane) and is time sensitive. It again averages 48 hours.

The other costs provided in Table 2.7 are the support costs for the floating crane and personnel from other activities. The cranes were provided by the Long Beach Naval Shipyard; However since BRAC the cranes are no longer available requiring leasing from a commercial activity. The cost for leasing floating crane support was provided by the planning department at Seal Beach. It is $6,000 per day. Long Beach also previously provided additional riggers and crane operators. These personnel are no longer available through Long Beach and would be provided by some other activity or internally. The crane cost of $6,000 per day includes crane operators. This reduces to 9 the "number of other station crew support" listed as 13 in the 1992 cost study. These costs are charged at the RSS&I rate multiplied by both the number of personnel (9) and the time established to support the evolution.

Material Type	Loading Barge & Ship (Inclusive)	Floating Crane Support (Leased)	Other Station Personnel Support
LFORM	$56,273.43	$12,178.22	$18,852.63
LFORM - 1.2 (18)	$17,842.80	$3,861.39	$5,977.66
SHIP'S FILL	$7,320.12	$1,584.16	$2,452.38
EODMU	$2,287.54	$495.05	$766.37
MISSION ALLOW.	$27,175.95	$5,881.19	$9,104.44
TOTAL COST	**$110,899.84**	**$24,000.00**	**$37,153.49**

Table 2.7 Barge, Ship, and Other Station Personnel Support Costs (Anchorage Onload)

8. Tug Support

The tug support was provided by the Long Beach Naval Shipyard. This support consists of three stages:

- Preparation for the ship's arrival (moving the barges to and from the wharf to the ordnance berthing area),
- The load/offload of ordnance, personnel, and equipment,
- The operation cleanup (movement of barges from the ship and ordnance berthing areas to the wharf.

Currently, Seal Beach conducts a bi-weekly (every two weeks) trip by barge to North Island (San Diego) to transport ordnance material. The normal contract for tug support would not cover for support in an anchorage operation; ordnance onload/offload would require additional funding. Table 2.8 provides an overview by stages for tug support in the onload operation.

Material Type	Preparation Tug Support	Load / Offload Tug Support	Cleanup Tug Support
LFORM	$5,169.65	$20,678.61	$3,446.44
LFORM - 1.2 (18)	$1,639.16	$6,556.63	$1,092.77
SHIP'S FILL	$672.48	$2,689.90	$448.32

Material Type	Preparation Tug Support	Load / Offload Tug Support	Cleanup Tug Support
EODMU	$210.15	$840.59	$140.10
MISSION ALLOW.	$2,496.56	$9,986.26	$1,664.38
TOTAL COST	**$10,188.00**	**$40,752.00**	**$6,792.00**

Table 2.8 Tug Support Costs (Anchorage Onload)

H. COST ANALYSIS FOR OFFLOAD OPERATIONS

The offload operation contains similar processes and cost fields. This section breaks down the processes identified earlier for an offload operation in their order of occurrence. The 1992 cost study used management information to figure the number of pallets which would be unloaded from various class ships. The number was based on the pallets onloaded minus the expected amount used for training, mission, etc. (Smith, 1992).

1. Tug Support

The tug scheduling and operations provide the first physical step in the offload process. The table represents three tug evolutions: the loading of personnel and equipment and transportation to the ship (referred to as "downloading" the ship), the actual offload, and the cleanup stage. Table 2.9 presents an overview of the tug support costs.

Material Type	Download Tug Support	Load / Offload Tug Support	Cleanup Tug Support
LFORM	$5,169.65	$20,678.61	$3,446.44
LFORM - 1.2 (18)	$1,639.16	$6,556.63	$1,092.77
SHIP'S FILL	$672.48	$2,689.90	$448.32
EODMU	$210.15	$840.59	$140.10
MISSION ALLOW.	$2,496.56	$9,986.26	$1,664.38
TOTAL COST	**$10,188.00**	**$40,752.00**	**$6,792.00**

Table 2.9 Tug Support Costs (Anchorage Offload)

2. Barge, Ship and Crane Support Costs

Table 2.10 is an overview of the offload support costs for other station personnel, commercial cranes and the offload evolution costs from the weapon station.

Material Type	Floating Crane Support (Leased)	Other Station Personnel Support	Loading Barge & Ship (Inclusive)
LFORM	$12,178.22	$18,852.63	$56,273.43
LFORM 1.2 (18)	$3,861.39	$5,977.66	$17,842.80
SHIP'S FILL	$1,584.16	$2,452.38	$7,320.12
EODMU	$495.05	$766.37	$2,287.54
MISSION ALLOW.	$5,881.19	$9,104.44	$27,175.95
TOTAL COST	**$24,000.00**	**$37,153.49**	**$110,899.84**

Table 2.10 Barge, Ship, and Other Station Personnel Support Costs (Anchorage Offload)

3. Onload Conveyance at the Wharf

These costs are derived from the percent of material shipped on the station in railcars and trucks. Table 2.11 provides the amount shipped by each and their respective costs.

Material Type	# of Pallets Railcar	# of Pallets Station Truck	Onload Conv Wharf (Rail)	Onload Convey Wharf (Trk)
LFORM	554	62	$16,925.48	$1,880.61
LFORM 1.2 (18)	176	20	$5,366.61	$596.29
SHIP'S FILL	72	8	$2,201.69	$244.63
EODMU	23	3	$688.03	$76.45
MISSION ALLOW.	267	30	$8,173.77	$908.20
TOTAL COST	**1,091**	**121**	**$33,355.57**	**$3,706.17**

Table 2.11 Onload Conveyance Costs at the Wharf (Anchorage Offload)

4. Segregation Costs

Material assigned to a unit or ship that has been opened or that has had its integrity violated requires segregation. This involves certifying that the material is not damaged, has the correct lot number, and is either serviceable (or unserviceable) and is entered back into the inventory system. The segregation quantity is based on a percentage of the quantity offloaded. All material transported to the segregation facility is assumed to use the Seal Beach rail system. Table 2.12 contains the percentage of material sent to segregation, the transfer costs, and the receipt (unloading) costs.

Material Type	% of Total Plts	# of Pallets to Seg	Transfer to Seg	Receipt at Seg
LFORM	3%	18	$62.69	$188.06
LFORM 1.2 (18)	3%	6	$19.88	$59.63
SHIP'S FILL	98%	78	$266.38	$799.13
EODMU	20%	5	$16.99	$50.97
MISSION ALLOW.	98%	291	$988.92	$2,966.77
TOTAL COST/PLTS		**399**	**$1,354.85**	**$4,064.56**

Table 2.12 Transfer and Receipt Costs to Segregation (Anchorage Offload)

Table 2.13 provides the costs for segregation. The cost for segregation is based on a standardized work hours per ton rate of 5.50 hours per ton. For this analysis, a pallet is assumed to weigh .67 tons. Other costs include loading the segregated material, the material's transfer, and receipt at the magazine.

Material Type	Segregation	Load at Segregation	Transfer to Mag from Seg	Receipt at Magazine
LFORM	$6,930.04	$225.67	$50.15	$188.06
LFORM 1.2(18)	$2,197.33	$71.55	$15.90	$59.63
SHIP'S FILL	$29,447.98	$958.96	$213.10	$799.13
EODMU	$1,878.06	$61.16	$13.59	$50.97

Material Type	Segregation	Load at Segregation	Transfer to Mag from Seg	Receipt at Magazine
MISSION ALLOW.	$109,325.64	$3,560.13	$791.14	$2,966.77
TOTAL COST	**$149,779.06**	**$4,877.47**	**$1,083.88**	**$4,064.56**

Table 2.13 Segregation and Transfer Costs (Anchorage Offload)

5. Transfer to Magazine/Marshaling Area Costs

The material not shipped to segregation is loaded aboard the station's railcars and trucks and delivered to either the station's magazines for stowage, or to the marshaling area for shipment to Fallbrook. A breakdown of pallets loaded aboard rail and truck, and their respective costs are presented in Table 2.14.

Material Type	# Pallets Railcar	# Pallets Station Trk	Transport Cost(Rail)	Transport Cost (Trk)	Receipt Costs-Mag
LFORM	535	62	$1,454.34	$25,450.90	$6,080.63
LFORM 1.2(18)	170	20	$461.13	$8,069.80	$1,928.01
SHIP'S FILL	0	2	$0.00	$0.00	$16.31
EODMU	18	3	$47.57	$832.43	$203.86
MISSION ALLOW.	0	6	$0.00	$0.00	$60.55
TOTAL PLTS/COSTS	**722**	**91**	**$1,963.04**	**$34,353.13**	**$8,289.36**

Table 2.14 Transportation and Receipt Costs from Wharf (Anchorage Offload)

6. Transportation Costs Interstation, Seal Beach to Fallbrook

Certain quantities of material are transferred to Fallbrook, because the amount offloaded exceeds the LFORM maintained at the Seal Beach magazines. In addition Fallbrook conducts the intermediate level maintenance for air launched missile systems. Table 2.15 provides the costs for preparing and commercially transporting material from Seal Beach to Fallbrook.

Material Type	# Pallets to Fallbrook	Scheduled Comm Trk	Load Convey	Trvl & Setup Cost	Transfer Costs
LFORM	492	$1,845.00	$9,026.92	$1,002.99	$19,680.00
LFORM 1.2 (18)	176	$658.13	$3,219.97	$357.77	$7,040.00
SHIP'S FILL	0	$0.00	$0.00	$0.00	$0.00
EODMU	0	$0.00	$0.00	$0.00	$0.00
MISSION ALLOW.	0	$0.00	$0.00	$0.00	$0.00
TOTAL PLT/COST	**668**	**$2,503.13**	**$12,246.89**	**$1,360.77**	**$26,700.00**

Table 2.15 Interstation Transfer Costs, Seal Beach to Fallbrook (Anchorage Offload)

7. Transfer Depot and Transport Intrastation Costs, Fallbrook

Material arriving at Fallbrook is either immediately processed to the magazines or rework facility or it remains at the transfer depot. Material at the transfer depot is transferred from the commercial truck and loaded onto station (public works) trucks for transportation, unloading, and receipt at the magazines and rework facilities. Table 2.16 represents the final costs in an anchorage offload operation.

Material Type	# Pallets at Tran Depot	Receipt at Tran Depot	Load Conv Tran Depot	Trans to Magazines	Offload in Magazines
LFORM	369	$7,522.43	$3,761.22	$805.98	$5,014.96
LFORM 1.2 (18)	132	$2,683.31	$1,341.65	$287.50	$1,788.87
SHIP'S FILL	0	$0.00	$0.00	$0.00	$0.00
EODMU	0	$0.00	$0.00	$0.00	$0.00
MISSION ALLOW.	0	$0.00	$0.00	$0.00	$0.00
TOTAL PLT/COST	**501**	**$10,205.74**	**$5,102.87**	**$1,093.47**	**$6,803.83**

Table 2.16 Transfer Depot and Intrastation Cost, Fallbrook (Anchorage Offload)

I. SUMMARY OF ANCHORAGE OPERATION COSTS

Table 2.17 is an overview of the previous operation costs broken down by whether it is an onload or offload operation. Chapter III will compile the operation costs for vertical operation (vertrep) onload and offload operations. The costs for both type of operations (anchorage and vertrep) will be compared in Chapter IV using the deterministic costs presented in this chapter and Chapter III; a stochastic analysis is also presented in Chapter IV.

Material Type	Total Anchorage Onload Costs	Total Anchorage Offload Costs
LFORM	$225,651.84	$224,381.68
LFORM 1.2 (18)	$73,008.49	$73,073.99
SHIP'S FILL	$25,375.59	$50,073.89
EODMU	$8,184.70	$8,647.11
MISSION ALLOW.	$94,206.87	$186,899.31
TOTAL COSTS	**$426,427.49**	**$542,075.98**

Table 2.17 Summary of Anchorage Operation Costs

III. VERTICAL REPLENISHMENT OPERATIONS, FALLBROOK

This chapter provides background on the Fallbrook Detachment and its role in supporting the pacific fleet. The chapter also describes vertical replenishment (vertrep) operation costs, develops of the model, and summarizes costs by operation (onload and offload) based on historical analysis, actual costs and anticipated ordnance requirements.

A. BACKGROUND

Naval Ordnance Center, Pacific Division, Fallbrook Detachment (Fallbrook) is located on 8849 acres, 71 miles north of San Diego (North Island) and 80 miles southwest of NWS Seal Beach (OrdBrief, 1994). Fallbrook receives, segregates (limited), stores and issues a majority of the Marine Corps' Pacific Fleet requirements and the Pacific Fleet's air launched and conventional ammunition weapon system requirements. Fallbrook also provides intermediate level maintenance for air launched missile systems and Marine Corps ammunition renovation. Supporting this mission, Fallbrook maintains 198 magazines and 12 warehouses with 618,422 square feet of storage (NOCPACDIV, 1995). Fallbrook's ordnance contribution of (2.5 billion in ammunition of which 75% is Marine) particularly critical to the Marine Corps' Pacific Fleet requirements, totaling 45 days of ammunition (Milcon P-553 Mtg, 1994).

Fallbrook's strengths include the amount of magazine storage and its close proximity to Camp Pendleton, San Diego, and the fleet homeported at North Island. The steaming time from San Diego to Camp Pendleton is half that of San Diego to Seal Beach (NOC PACDIV, 1995). The use of vertrep provides realistic training for aircrews and Marine helicopter support teams. Vertreps provide more flexibility for supporting the fleet, requiring less time to set up and execute than anchorage operations (NOC PACDIV, 1995). Additionally, vertreps require no barges, lighters, tugs or floating cranes. Finally, all ordnance transportation is within the two Naval installations (Fallbrook and Camp Pendleton), which requires less blocking and bracing, and increases public safety.

B. ASSUMPTIONS

Assumptions were listed in Chapter II and are consistent throughout this study. Based on the data provided in the 1992 cost study, Fallbrook maintains approximately 96% of the LFORM requirements and 51% of the other conventional munition requirements aboard the station (Smith, 1992).

The 1992 cost study used the ship's fill quantities based on the 11/5/91 - 11/7/91 USS Okinawa (LPH) vertrep onload and the 2/11/92 - 2/14/92 USS Tarawa (LHA) vertrep onload. The study used management information to determine the number of pallets to be offloaded from the different class ships. The number was based on the pallets onloaded minus the expected amount used for training, mission, etc (Smith, 1992). For this thesis, the estimated times and costs are extrapolated based on that study and observation of various evolutions to provide estimated helicopter operation times.

C. ONLOAD AND OFFLOAD OPERATIONS

The 1992 study used days of evolution for helicopter and pad costs. Because the critical cost in the vertrep is helicopter time, a more accurate allocation is required. Additionally, the days of evolution used three helicopters instead of the five used in operations since 1992. Since 1992, Fallbrook changed the vertrep operations to improve planning. One change is a standard anchorage area for the ship. Prior to setting anchorage range for the ships, the helicopters had to fly between two thousand and four thousand meters offshore. The anchorage is now two thousand meters, reducing both flight time and operation costs.

D. PROCESS OPERATIONS FOR A VERTREP ONLOAD

The process flow and allocable costs for a vertrep operation were determined through observation and interviews conducted during the 1992 cost study. The date was modified for changes made since the study. These modifications attempt to more accurately depict the operations costs based on hourly charges, instead of "days of evolution." The process for a vertrep onload is outlined below.

- Preparation of material, Fallbrook
- Preparation of material, Seal Beach
- Preparation travel and setup, Fallbrook
- Preparation travel and setup, Seal Beach
- Material requiring double handling - travel and handling, Fallbrook
- Material requiring double handling - travel and handling, Seal Beach
- Schedule commercial trucks, Seal Beach
- Load ordnance material, Seal Beach
- Transport material intrastation, Seal Beach
- Transport material to Fallbrook
- Offload conveyance from commercial truck, Fallbrook
- Load conveyance for transport to pad, Fallbrook

- Travel and Setup for pad
- Offload conveyance at pad
- Additional personnel support (military and civilian) to support operation
- Helicopter operations (onload pad to ship)

E. PROCESS OPERATIONS FOR A VERTREP OFFLOAD

Comparably, the offload process for a vertrep operation was determined through interviews, observation, and the 1992 cost study. A problem mentioned in determining the offload costs for anchorage operations is the planners' inability to accurately predict the condition of the retrograde material and control its movement by type. In vertrep operations, this means setting aside enough unique material for later transport, minimizing partial truckloads. The offload process is detailed as follows.

- Offload ship to pad (helicopter operations)
- Additional personnel support (military and civilian) to support operation
- Load conveyance at pad
- Transport material from pad to Fallbrook
- Receive material at magazine/segregation (% to magazine/ % to segregation)
- Load conveyance
- Transport material to segregation
- Receive material at segregation
- Segregate at Fallbrook
- Load conveyance for magazine
- Transport to magazine from segregation
- Receipt at magazine (Fallbrook)
- Schedule commercial trucks

- Transfer material to commercial truck (direct to Seal Beach)
- Transport to Seal Beach
- Receipt at Seal Beach detention yard
- Load conveyance detention yard
- Transport to magazine(s)
- Offload material to Seal Beach magazine

F. BENEFITS

Like Seal Beach, Fallbrook is the close to San Diego, Camp Pendleton, and the fleet located at North Island. Additionally, Fallbrook has minimal encroachment by the civilian community; important from an explosive safety point of view. The location is primarily bordered by Camp Pendleton, and national forest land; and only shares a short border with the town of Fallbrook. This lack of encroachment and the large magazine area allows Fallbrook to expand its storage (magazines) and missile work (further building) areas, and continue reimbursable work with the Marine Corps at both Camp Pendleton and programs located aboard Fallbrook.

Vertrep operations are conducted from Confined Area Landing Site 20 (CAL Site 20) aboard Camp Pendleton. The site operates under an explosive safety waiver that allows it to handle all ordnance up to 1.2 category 18. The designator requires an explosive safety arc of 1800 feet (hence the 18). Vertrep operations use an external load (the ordnance hangs from below the aircraft) and are prohibited from crossing highways. Ordnance can be transported from Fallbrook to Camp Pendleton (CAL Site 20), without leaving the confines of a military reservation. This reduces the cost and time for transportation; requirements are more lenient while on-station.

G. COST ANALYSIS FOR ONLOAD OPERATIONS

An overview of the percentage of ordnance material provided by Fallbrook and Seal Beach for vertrep operations is included in Table 3.1. The percentages of ordnance material provided by each location was derived from the 1992 study. To remain consistent with the 1992 study, a standard load of 1212 pallets was used. The amount provided by location is summarized below.

Material Type	Total Pallets	Percent From Seal Beach	Pallets From Seal Beach	Pallets From Fallbrook
LFORM	615	6%	37	578
LFORM 1.2 (18)	195	0%	0	195
SHIP'S FILL	80	38%	30	50
EODMU	25	30%	8	18
MISSION ALLOW.	297	41%	122	175
TOTAL PLTS	**1,212**		**197**	**1,015**

Table 3.1 Breakdown of Pallets by Station for an LHA Vertrep Operation
From Ref (Smith, 1992)

1. Preparation and Travel And Setup Costs

The definition of preparation, travel and setup activities for a vertrep operation are the same as for an anchorage operation, discussed in Chapter II. Table 3.2 provides the costs for preparing the material, and its related travel and setup costs by station for the quantities previously listed.

Material Type	Est. Hrs./ Plt. Prep	Prep Cost Seal Beach	Prep Cost Fallbrook	Trvl & Setup Seal Beach	Trvl & Setup Fallbrook
LFORM	.22	$1,654.94	$25,927.32	$300.90	$7,365.72
LFORM 1.2 (18)	.22	$0.00	$8,745.59	$0.00	$2,484.54
SHIP'S FILL	.27	$1,673.28	$2,730.09	$247.89	$631.97
EODMU	.32	$489.26	$1,141.62	$61.16	$222.97
MISSION ALLOW.	.27	$6,702.49	$9,645.04	$992.96	$2,232.65
TOTAL COST		**$10,519.97**	**$48,189.67**	**$1,602.91**	**$12,937.85**

Table 3.2 Preparation Costs (Vertrep Onload)

2. Double Handled Material

The double handling of material described for anchorage operations also applies to vertrep operations. Those costs are broken down into the travel and load costs for each station. Table 3.2, Double Handling Costs (Vertrep Onload) provides the allocated costs.

Material Type	Dbl Hnd - Trv Seal Beach	Dbl Hnd - Trv Fallbrook	Dbl Hnd - Ld Seal Beach	Dbl Hnd - Ld Fallbrook
LFORM	$398.69	$3,977.49	$398.69	$7,954.97
LFORM 1.2 (18)	$0.00	$1,341.65	$0.00	$2,683.31
SHIP'S FILL	$328.46	$341.26	$328.46	$682.52
EODMU	$81.03	$120.40	$81.03	$240.81
MISSION ALLOW.	$1,315.67	$1,205.63	$1,315.67	$2,411.26
TOTAL COST	**$2,123.86**	**$6,986.44**	**$2,123.86**	**$13,972.88**

Table 3.3 Double Handling Costs (Vertrep Onload)

3. Transportation Costs, Seal Beach to Fallbrook

Intrastation (within Seal Beach) conveyance utilizes the large rail system to transport its ordnance. The cost for using the rail system is captured under the RSS&I stabilized rate for two workers (the engineer and switchman) multiplied by the per pallet transportation time and the number of pallets per railcar (30). The costs for commercial conveyance from Seal Beach to Fallbrook used in the 1992 were provided by the Seal Beach Traffic Manager. The information for commercial transport from Seal Beach to Fallbrook is:

- Category I and II = $ 812
- Category III and IV = $ 626

Current information provided by the Transportation Officer at Fallbrook is similar. The 1992 study used an average of $750 based on the amounts and type of loads carried for the analysis. This same average cost is incorporated into the interstation conveyance costs using commercial vehicles. Table 3.4 contains the cost for scheduling commercial vehicles, loading the material, Intrastation (within Seal Beach) transportation, and finally Interstation (Seal Beach to Fallbrook) transportation.

Material Type	Sched Cost Comm Trk	Load Convey at Seal Beach	Tvl Intrastation Costs (S.B.)	Tvl Interstation Costs (S.B.)
LFORM	$138.38	$677.02	$225.67	$1,383.75
LFORM 1.2 (18)	$0.00	$0.00	$0.00	$0.00
SHIP'S FILL	$114.00	$557.76	$185.92	$1,140.00
EODMU	$28.13	$137.61	$45.87	$281.25
MISSION ALLOW.	$456.64	$2,234.16	$744.72	$4,566.38
TOTAL COSTS	**$737.14**	**$3,606.55**	**$1,202.18**	**$7,371.38**

Table 3.4 Interstation Transfer Costs (Vertrep Onload)

4. Transfer Depot Costs

The transfer depot costs are unique to the vertrep operation. Seal Beach has a designated area for detained trucks. The detained truck area allows Seal Beach to evaluate whether it is cost effective to hold the trucks (paying a detention fee) or unload the vehicle and incur double handling costs. Fallbrook is setting up a detention area, but until it is approved explosive safety rules require Fallbrook to unload the vehicles into a magazine area (increasing the double handling). The transfer depot costs include the offloading, receipting, and travel and setup for commercial transportation from Seal Beach and are included in Table 3.5.

Material Type	# of Pallets Commercial Trk	Offload Convey Commercial Trk	Travel & Setup Commercial Trk
LFORM	37	$376.12	$188.06
LFORM 1.2 (18)	0	$0.00	$0.00
SHIP'S FILL	30	$309.87	$154.93
EODMU	8	$76.45	$38.22
MISSION ALLOW.	122	$1,241.20	$620.60
TOTAL PLTS/COST	**197**	**$2,003.64**	**$1,001.82**

Table 3.5 Transfer Depot Costs (Vertrep Onload)

5. Intrastation Transportation Costs, Fallbrook

The Intrastation charges include two separate stages. The first is loading the material, and its associated travel and setup charges. These are broken down in subsection 6. The second is the scheduling and actual transportation charges. Fallbrook uses both Public Works and Camp Pendleton's Base Motor Transport Department's vehicles to transport ordnance aboard the two bases. Remaining on military reservations (Camp Pendleton and Fallbrook) and using tractor trailers from Fallbrook's Public Works and Camp Pendleton's Base Motor Transport Department reduces cost.

The charges for public works vehicles are based on the hours of use multiplied by the crew (driver) and the RSS&I rate. Because the vehicle's transportation charge only accounts for the actual time the vehicles are used for transportation, the travel time (round-trip) is used for transportation costs. The time the vehicle is being loaded/unloaded is included in the conveyance costs.

Base Motor Transport vehicles are billed on hours and mileage. $11.91 dollars per hour is the rate for a transport driver (military or civilian) and vehicle. The amount may be higher if the transport department is over tasked and must use outside commercial temporary drivers to augment their drivers. The additional cost is then spread over all units requiring support so the increase is minimal (Rogers, 1995). The 1992 study identified this for a higher rate budgeting; however, historical data does not support a higher hourly charge. The number of hours are assumed using the trucks for the entire evolution, plus one day for pre-staging ordnance on the vehicles. The mileage assumes two trips per day (round-trip of 46 miles) for each of the vehicles.

The percent of truck supplied from each command corresponds to historical usage; the costs are allocated on that percentage. Table 3.6 provides a breakdown of pallets by each transportation source and the associated costs during the evolution.

Material Type	# of Pallets Public Works	# of Pallets Base Motors	Public Works Trans Costs	Base Motors Trans Costs
LFORM	256	359	$1,462.70	$7,776.44
LFORM 1.2 (18)	81	114	$463.78	$2,524.13
SHIP'S FILL	33	47	$190.27	$1,086.00
EODMU	10	15	$59.46	$398.20
MISSION ALLOW.	124	173	$706.37	$3,799.69
TOTAL PLTS/COST	**505**	**707**	**$2,882.58**	**$15,584.47**

Table 3.6 Intrastation Transportation Costs (Vertrep Onload)

6. Intrastation Conveyance Costs to Helicopter Pad

The route to CAL Site 20 for helicopter operations is approximately 23 miles (NOCPACDIV Pre-Arrival Doc., 1995). The site is located north of the Las Pulgas exit on Interstate 5. This site is currently under waiver until a new site is built farther south. The waiver is for the explosive safety quantity distance arc (ESQD) crossing I-5 at 1700 feet (AMHAZ, 1994). CAL Site 20 has two helicopter pads. Material can be staged on one pad while helicopters pick up material on the second. Each site is capable of holding up to 50 pallets. Because the vehicles and crew offloading the conveyance at the pad are not finished until the operation is concluded (helicopter operations), the hours for the pad offload crew (a truck driver, a safety ground guide, and a forklift operator) equals the days of evolution (helo) multiplied by 9 hours per day. The total cost for offloading conveyance is equal to the crew time multiplied by the RSS&I rate. Likewise, the pad operating crew consists of two ground guide/net riggers per pad and the operations foreman (a crew of 5). The pad operating crew costs reflect the same computation for operations time multiplied by the RSS&I rate.

Table 3.7 provides the costs for loading the conveyance aboard station and/or base motor vehicles, travel and setup for transportation to the pad, and offloading the material at the pad.

Material Type	# of Pallets Vertrep Ops	Load Convey for Pad	Trvl & Setup for Pad	Offload Conv at Pad
LFORM	615	$6,268.70	$3,134.35	$4,189.47
LFORM 1.2 (18)	195	$1,987.64	$993.82	$1,328.37
SHIP'S FILL	80	$815.44	$407.72	$544.97
EODMU	25	$254.83	$127.41	$170.30
MISSION ALLOW.	297	$3,027.32	$1,513.66	$2,023.21
TOTAL PLTS/COST	**1212**	**$12,353.92**	**$6,176.96**	**$8,256.33**

Table 3.7 Intrastation Conveyance Costs to Pad (Vertrep Onload)

7. Helicopter Operation and Support Costs

The operation costs at the helicopter pad involve military and civilian support. The helicopter support team (HST) is a four person Marine crew that hooks the pallet to the helicopter. Aboard the ship, a Navy support team conducts a similar function as part of the

ship's crew. A follow up to the 1992 study concluded that the cost for Marine/Navy personnel should be based on the RSS&I cost per person. The assumption was that if military personnel were not available due to a conflict (war) that civilians would perform this function. However, this is probably not true. If the Marines were not available, then the ship's crew would perform this function (as was the case during the war in Southwest Asia). The 1992 study used a rate of $5.50 based on the average civilian equivalent rank for the military personnel; this thesis uses a rate of $13.66 (WG-7, step 2).

Helicopter operation costs are based on one-half of the actual cost for operating a military helicopter for a mission. The percentage for reimbursement was coordinated through an ISA between AirPac and Fallbrook. The current charge to Fallbrook is $1500 per hour. The percentage charged to Fallbrook was determined from the amount of flight hours that could be validated by the supporting squadron as training. If these operations were not conducted the equivalent training would be conducted at Camp Pendleton carrying blocks of cement in touch and goes (takeoffs and landings). Using the Navy and Marine squadrons for this mission is a win-win situation; operation costs are reduced for training and the vertrep operation is funded partially by AirPac's Operating funds.

The amount of flight time for this evolution includes three different elements: flight time, refueling time and training time. The first is flight hours for lifts. To determine the number of lifts, historical records were reviewed for an "average" lift per ton; onload operations averaged .8522 lifts per ton; offload operations averaged .8925 lifts per ton. The total tonnage derived using .67 tons per pallet multiplied by the amount of pallets. Using observation and historical figures, an average time from "hookup" to "drop off" is two minutes, thirteen seconds. Using a conservative estimate of six and one-half minutes round trip, the estimated flight time per lift is multiplied by the amount of lifts. These figures provide the total lift time.

The second element in the flight operations hours is refueling time (time not used carrying ordnance). Helicopters refuel for 20 minutes after every four hours of flight time. This operation is staggered between the aircraft on most of the ships to allow continuous vertrep operations to proceed. On other ships, the ordnance operations must be halted to clear the deck to refuel the aircraft. The aircraft arrive "full" and return to station "low." More frequent refueling operations will not increase the available hours because the hours are based on the flight hours. During an eight hour evolution, maximum amount of flight time on station, the helicopter would require 20 minutes refueling leaving 7 hours and 40 minutes for ordnance lift time.

The final area taken into consideration for helicopter flight hours is transit time from the air station to CAL Site 20. The transit time is one-half hour in each direction, with the squadron limited to 9 hours of flying time per helicopter per day. A summary of personnel support, helicopter support, and helicopter operations costs are provided in Table 3.8.

Material Type	Personnel Support on Pad (Fallbrk)	Helicopter Spt Team (Military)	Helicopter Operation Costs
LFORM	$6,982.46	$1,684.34	$71,386.37
LFORM 1.2 (18)	$2,213.95	$534.06	$22,634.70
SHIP'S FILL	$908.29	$219.10	$9,286.03
EODMU	$283.84	$68.47	$2,901.88
MISSION ALLOW.	$3,372.02	$813.41	$34,474.39
TOTAL COST	**$13,760.55**	**$3,319.38**	**$140,683.37**

Table 3.8 Personnel and Helicopter Operations Costs (Vertrep Onload)

H. COST ANALYSIS FOR OFFLOAD OPERATIONS

In the 1992 cost study, both the anchorage and vertrep onload operations received ordnance material from Seal Beach; however, during the vertrep offload no material returned to Seal Beach for storage. In addition, the cost study stated there is no segregation facility at Fallbrook. However, the study did not transport material to Seal Beach for segregation; it accounted for the material at Fallbrook. This analysis uses these same assumptions, because it is beyond the scope to determine why the costs were not changed to correct these inconsistencies.

The offload information used in the 1992 study includes four scenarios: Two LHA offloads, one uses a Landing Craft, Utility (LCU) to handle the class 1.2 (18) through Seal Beach, the other does not use the LCU and no ordnance is handled through Seal Beach. The other two scenarios involve a Landing Platform Dock (LPD), again with and without an LCU. This analysis combines the average load information (1212 pallets) and incorporates the information into a scenario without LCU support.

1. Helicopter Operation and Support Costs

The helicopter operation costs and the support costs are based on the number of flight hours and days of evolution at the pad. Changes in costs from an onload operation reflect the lift per tonnage rate, which is based on historical data. The higher offload lift per ton rate could result from mixed/broken ordnance lots. This reduces lifts but increases segregation costs. The onload operation, more concerned about lot integrity, would palletize in smaller packages to maintain the lot configuration. The other costs would be similar for both onload and offload operations. A breakdown of these costs is presented below in Table 3.9.

Material Type	Personnel Support on Pad	Helicopter Spt Team (Military)	Helicopter Operation Costs
LFORM	$6,982.46	$1,684.34	$74,418.99
LFORM 1.2 (18)	$2,213.95	$534.06	$23,596.26
SHIP'S FILL	$908.29	$219.10	$9,680.52
EODMU	$283.84	$68.47	$3,025.16
MISSION ALLOW.	$3,372.02	$813.41	$35,938.93
TOTAL COST	**$13,760.55**	**$3,319.38**	**$146,659.86**

Table 3.9 Personnel and Helicopter Operations Costs (Vertrep Offload)

2. Intrastation Transportation Costs, Fallbrook

This section contains the transportation costs for Fallbrook public works' and Camp Pendleton Base Motor's vehicles. The public works vehicle costs are based on the operation hours for the vertrep. The Base Motor's costs are similar to the onload operation costs. They assume the same number of vehicles and pallets, but use a four hour prestage time, instead of an eight hour time. The vehicle (tractor trailer) is prepared to carry ordnance by a block and bracer at Fallbrook. This allows the tractor trailer to use straps for lashing down the load rather than off-station block and bracing, which requires more material and time to prepare the load. A breakdown of pallets and their associated costs for both sources of vehicles is given in Table 3.10.

Material Type	# of Pallets P.W. Trucks	# of Pallets B.Mtr Trucks	Trans Costs (Public Works)	Trans Costs (Base Motors)
LFORM	256	359	$1,462.70	$7,776.44
LFORM 1.2 (18)	81	114	$463.78	$2,524.13
SHIP'S FILL	33	47	$190.27	$1,086.00
EODMU	10	15	$59.46	$398.20
MISSION ALLOW.	124	173	$706.37	$3,799.69
TOTAL PLTS/COST	**505**	**707**	**$2,882.58**	**$15,584.47**

Table 3.10 Intrastation Transportation Costs, Fallbrook (Vertrep Offload)

3. Conveyance Costs to Segregation

Conveyance costs of segregated material assumes that material requiring segregation will be set aside on the pad. Once delivered to Fallbrook, it will be directed to the segregation area. The segregation conveyance and travel and setup charges are derived using the same formulas as the onload costs. The percent of pallets by material is taken from the 1992 cost study. These percents, and the quantity of pallets, and the associated conveying, travel and setup costs are provided in Table 3.11.

Material Type	% to Seg	# of Pallets to Segregation	Onload Convey for Segregation	Trvl & Setup for Segregation
LFORM	3%	18	$338.51	$94.03
LFORM 1.2 (18)	3%	6	$107.33	$29.81
SHIP'S FILL	96%	78	$1,438.44	$399.57
EODMU	20%	5	$91.74	$25.48
MISSION ALLOW.	98%	291	$5,340.19	$1,483.39
TOTAL PLTS/COST		**399**	**$7,316.21**	**$2,032.28**

Table 3.11 Conveyance, Travel and Setup Costs for Segregation (Vertrep Offload)

4. Segregation Costs from Transfer to Reloading Conveyance

This section provides an overview of the costs for transferring and receiving the material from the helicopter pad (offloading and documenting the material), the actual cost for segregation, and the cost for conveying the material for transportation to the magazine. The transfer costs assume all material is transported to Fallbrook, but material destined for segregation is further transported to the segregation facility. The costs for these segregation processes are detailed in Table 3.12.

Material Type	Transfer to Segregation	Receipt at Segregation	Segregation Costs	Onload Convey at Seg
LFORM	$47.02	$639.41	$6,930.04	$188.06
LFORM 1.2 (18)	$14.91	$202.74	$2,197.33	$59.63
SHIP'S FILL	$199.78	$2,717.05	$29,447.98	$799.13
EODMU	$12.74	$173.28	$1,878.06	$50.97
MISSION ALLOW.	$741.69	$10,087.03	$109,325.64	$2,966.77
TOTAL COST	**$1,016.14**	**$13,819.51**	**$149,779.06**	**$4,064.56**

Table 3.12 Segregation Costs (Vertrep Offload)

5. Transfer to Magazine from Helicopter Pad

The material not sent to segregation is conveyed, received and offloaded into the magazines at Fallbrook. This represents the final costs for material received directly from the helicopter pad. The areas presented in Table 3.13 are for the onloading the material, the travel and setup charges once the material is received at the transfer depot and the final offload and receipt of the material at the magazines.

Material Type	# of Pallets Direct to Mag	Onload Convey for Mag	Trvl & Setup for Magazine	Receipt at Mag from Pad
LFORM	597	$10,945.14	$3,040.32	$20,674.16
LFORM 1.2 (18)	189	$3,470.41	$964.00	$6,555.22
SHIP'S FILL	2	$29.36	$8.15	$55.45
EODMU	20	$366.95	$101.93	$693.12
MISSION ALLOW.	6	$108.98	$30.27	$205.86
TOTAL PLTS/COST	**813**	**$14,920.84**	**$4,144.68**	**$28,183.81**

Table 3.13 Transfer Costs Direct from Pad (Vertrep Offload)

6. Transfer to Magazine from Segregation

After the material is processed in segregation and reconstituted, it is transferred to the magazines at Fallbrook. No material is shipped from the segregation process to Seal Beach (Smith, 1992). A breakdown of the costs included in this transfer is provided in Table 3.14.

Material Type	# Plts from Seg	Transfer from Seg to Mag	Trvl & Setup Seg to Mag	Receipt at Mag from Seg
LFORM	18	$23.51	$94.03	$188.06
LFORM 1.2 (18)	6	$7.45	$29.81	$59.63
SHIP'S FILL	78	$99.89	$399.57	$799.13
EODMU	5	$6.37	$25.48	$50.97
MISSION ALLOW.	291	$370.85	$1,483.39	$2,966.77
TOTAL COSTS	**399**	**$508.07**	**$2,032.28**	**$4,064.56**

Table 3.14 Transfer Costs from Segregation (Vertrep Offload)

I. SUMMARY OF VERTREP OPERATION COSTS

An overview of the vertical replenishment costs for the onload and offload operations is given in Table 3.15. Chapter IV combines and compares the costs for the anchorage operations provided in Chapter III and those of this chapter. In addition, Chapter IV will compare the cost using "Crystal Ball," a spreadsheet simulation add-on program for a stochastic operation costs analysis.

Material Type	Total Vertical Replenishment Onload Costs	Total Vertical Replenishment Offload Costs
LFORM	$153,852.53	$135,527.20
LFORM 1.2 (18)	$47,935.54	$43,030.47
SHIP'S FILL	$22,884.24	$48,477.67
EODMU	$7,310.20	$7,312.21
MISSION ALLOW.	$85,415.16	$179,741.27
TOTAL COSTS	**$317,397.68**	**$414,088.83**

Table 3.15 Summary of Vertical Replenishment Operation Costs

IV. DISCUSSION OF ACTUAL COSTS

This chapter compares the costs attributed to onload and offload operations using "Crystal Ball," a Monte Carlo based spreadsheet program. Crystal Ball applies stochastic analysis to a deterministic model. The analysis will focus on the costs developed in Chapter II for anchorage operations and Chapter III for vertrep operations. The model is based on actual tonnage from previous operations and the estimated accuracy of the evolution times.

A. MODEL DEVELOPMENT

Simulation models represent systems over time. These models are either static or dynamic, deterministic or stochastic, and discrete or continuous. A static simulation model uses Monte Carlo simulation, to represent a system at a particular time (Law, 1982). This model was developed as a problem-solving technique during World War II, when John Von Neumann used "Monte Carlo" methods to successfully solve neutron diffusion problems. Monte Carlo simulation generates and uses random or chance variables to create a stochastic simulation in a deterministic model. "The limits to any simulation is that it is:

- Neither a science nor an art, but a combination of both,
- Generally yields suboptimum solutions,
- Validation difficult,
- Method of last resort." (Neelamkavil, 1987)

"Since most simulation models use random variables as input, the simulation output data are themselves random and care must be taken in drawing conclusions about the model's veracity" (Law, 1982).

The two models used for the comparison are based on the estimated process times, percentages, and vehicle loads. The first scenario uses a uniform distribution, where the minimum and maximum variables are established over uniform occurrence. The second scenario uses a random number generator "weighted" by the high, low, and "most likely" variables. For both of the scenarios, the number of pallets generated from actual operations (anchorage and vertrep) are used to develop the most likely "goodness-of-fit" distribution.

B. STANDARD LHA LOAD DEVELOPMENT

The "average load" used in Chapters II and III were provided in the 1992 cost study. These numbers were developed from standard and actual load plans, and management information. However, study of all vertrep and anchorage operations for LHA loads since 1990 presents a different perspective for the number of pallets. This thesis developed four

sets of data based on the actual tonnage onloaded and offloaded during vertrep and anchorage operations since 1990. Histograms were developed to determine if the raw data from these operations provide a "theoretical" distribution to accurately describe the discrete events.

The four sets of data used to develop histograms are: LHA only, LPH only, LHA and LPH, and All Class Ships. The graphs developed from these data sets, shown in Figure 4.1, provided no clear "fit" for a distribution form.

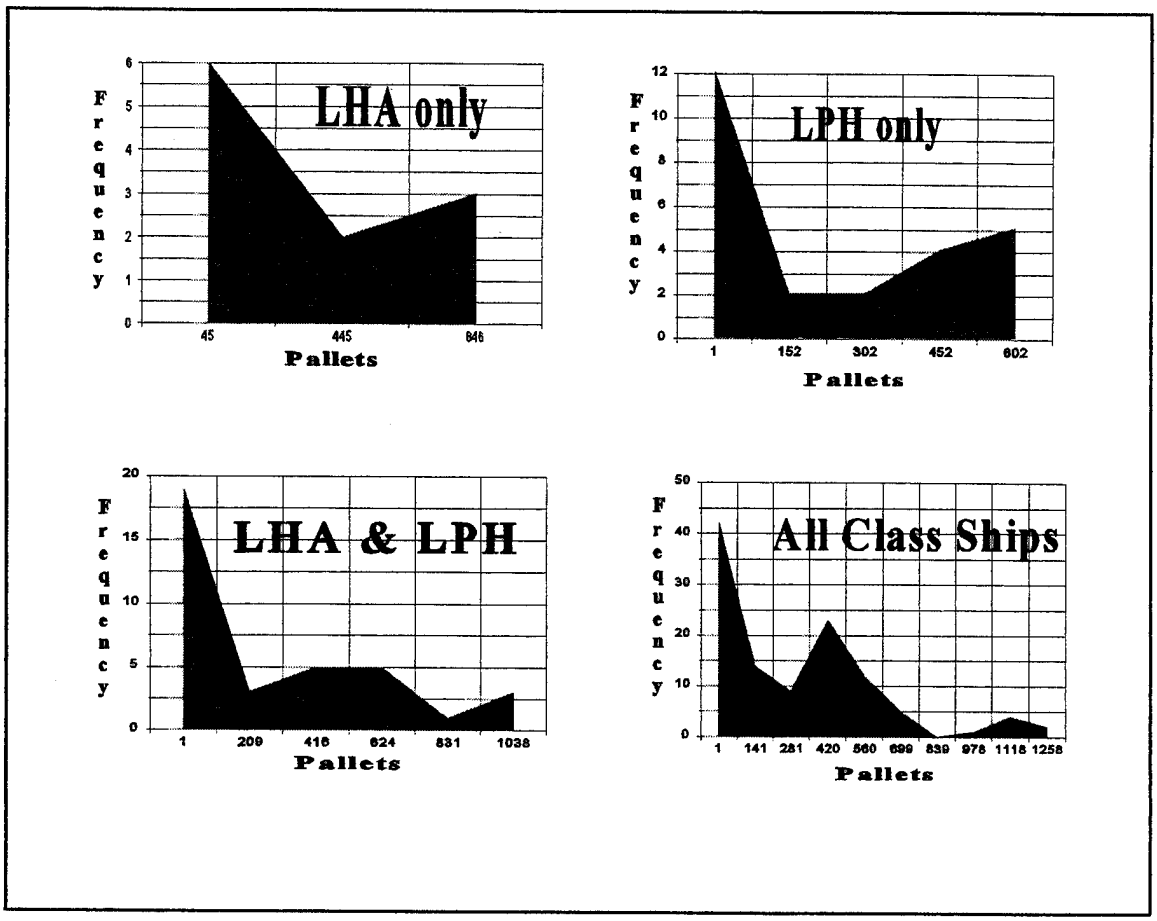

Figure 4.1 Area Distributions for Ship Load Data

The next process to develop the number of pallets used an empirical distribution to represent unique discrete events. Using a Monte Carlo simulation for 1,000 trials provides an "average" for each of the four data sets. The allocation of costs was derived from the amount of material (615 pallets of LFORM in the deterministic model) divided by the total number of pallets (1212). The stochastic pallet quantity of LFORM is 249 pallets (615 / 1212 multiplied by 490 pallets). These runs are summarized in Table 4.1.

Material	LHA	LPH	LHA & LPH	All Loads
LFORM	249	142	178	180
LFORM 1.2(18)	79	45	56	57
SHIP'S FILL	32	18	23	23
EODMU	10	6	7	7
MISSION ALLOW.	120	69	86	87
TOTAL PLTS	**490**	**280**	**350**	**354**

Table 4.1 Stochastic LHA Breakdown of Pallets

The decision about which set of data to use is based on several criteria. The "All Loads" data set is not useful because it includes aircraft carriers, ammunition ships, and most other ships that can be loaded in wharf operations. The number of pallets and the ship's ability to access to the wharf skews the data, primarily through partial loads ranging from one to 67 pallets. This data represents 20% of all loads in this data set. Similarly, the data sets including LPH data do not accurately portray how many pallets would be onloaded/offloaded in vertrep and anchorage operations. Finally, the "LHA Only" data set is limited because there are so few raw data points; its strength is that it uses actual anchorage and vertrep operations data. The cost by scenario using the stochastic LHA pallet count is provided in Table 4.2.

Material	Summary Anchorage Onload Costs	Summary Anchorage Offload Costs	Summary Vertrep Onload Costs	Summary Vertrep Offload Costs
LFORM	$160,921.57	$160,407.31	$112,599.52	$104,489.84
LFORM 1.2(18)	$51,647.06	$51,673.60	$35,415.96	$33,209.81
SHIP'S FILL	$19,089.68	$28,696.00	$15,663.77	$25,812.45
EODMU	$6,067.46	$6,252.42	$4,993.77	$4,966.86
MISSION ALLOW.	$71,586.32	$108,633.77	$58,782.45	$96,561.41
TOTAL COST	**$309,312.09**	**$355,936.10**	**$227,455.47**	**$265,040.38**

Table 4.2 Original Assumptions with Stochastic Pallet Count

C. UNIFORM DISTRIBUTION MODEL

The uniform distribution model uses the "best" and "worst" case scenarios to develop a range of variables. The uniform distribution is used as a "first" model for a quantity believed to randomly vary between a and b, but where little else about the distribution is known (Law, 1982). The simulation obtains a random variable, in which the probability is uniformly distributed over the entire interval.

The uniform distribution model is developed in two stages. The first stage is identifying the actual number of pallets comprising each operation based on the actual tonnage. To provide an accurate range, personnel familiar with the operations provided subjective estimates of the most likely time to perform the task. The second stage is to develop the process variables. These variables include: the time to process or travel, an average load of pallets per vehicle, and the percentage of pallets requiring double handling and shipping. Appendix E provides the models and variables developed for the Uniform Distribution Model Scenarios.

1. Number of Pallets per Operation

The actual number of pallets, derived by the process described above, is used throughout these models. The material breakdown (LFORM, EODMU, etc.) and the percentage provided by each station (Seal Beach and Fallbrook) are taken from the 1992 cost study.

2. Summary of Uniform Distribution Model Scenarios

Uniform distributions are used to estimate the critical values. Table 4.3 summarizes costs by scenario using a uniform distribution.

Material	Summary Anchorage Onload Costs	Summary Anchorage Offload Costs	Summary Vertrep Onload Costs	Summary Vertrep Offload Costs
LFORM	$168,879.08	$166,527.06	$115,651.75	$108,815.90
LFORM 1.2(18)	$54,291.45	$53,860.40	$36,306.57	$34,599.42
SHIP'S FILL	$19,724.41	$29,062.96	$16,282.33	$29,545.77
EODMU	$6,265.81	$6,249.69	$5,188.16	$5,341.08
MISSION ALW.	$73,966.52	$108,986.11	$61,105.67	$110,492.53
TOTAL COST	**$323,127.27**	**$364,686.22**	**$234,534.48**	**$288,794.71**

Table 4.3 Uniform Distribution Model Summarized Costs

D. TRIANGULAR DISTRIBUTION MODEL

A triangular distribution provides a "rough" model when data is limited. The model is developed in four stages. The first stage is to determine the number of pallets for each operation based on the actual tonnage. To remain consistent, the same number of pallets as determined earlier in this chapter has been used for all the comparisons. Next, the process times are developed using the triangular distribution. The triangular distribution is also used to estimate the average pallets per vehicle. Finally, a triangular distribution is used to estimate the percentage of pallets requiring double handling and shipping.

1. Listing of Variables

Because the operations vary greatly in size and individual processes, there is no "perfect" number to represent every operation. A triangular method simulates a range of variables based on estimates under optimal (usually full loads) and minimal (single load) conditions. In the triangular approach, personnel familiar with the operations provide their subjective estimate of the "most likely" time to perform the task. In this analysis, the most likely value is taken from the 1992 cost study. The triangular distribution also requires specifying the range. "Best" and "worst" case scenarios, developed by interviewing station personnel are used to estimate the range of variables. In this analysis, the "most likely" times, percentages, and amounts are based on both the 1992 cost study and the analysis conducted in the previous chapters. The range of variables for each of the Triangular Distribution Model scenarios are provided in Appendix F.

2. Summary of Triangular Distribution Model Scenarios

Table 4.4 summarizes the results using a triangular distribution model with "Crystal Ball." These figures will now be compared with the Uniform Distribution Model and the original scenario.

Material	Summary Anchorage Onload Costs	Summary Anchorage Offload Costs	Summary Vertrep Onload Costs	Summary Vertrep Offload Costs
LFORM	$165,395.28	$164,191.24	$114,527.24	$107,182.06
LFORM 1.2(18)	$53,137.26	$53,026.12	$35,986.61	$34,075.04
SHIP'S FILL	$19,435.13	$29,031.24	$16,038.49	$28,231.24
EODMU	$6,175.41	$6,250.41	$5,113.35	$5,205.67
MISSION ALW.	$72,881.73	$108,867.15	$60,182.12	$105,587.26
TOTAL COST	**$317,024.80**	**$361,366.16**	**$231,847.80**	**$280,281.27**

Table 4.4 Triangular Distribution Model Summarized Costs

E. COMPARISON OF OPERATION COSTS

Table 4.5 compares the results from each of the models: the original assumptions from Table 4.2, the uniform distribution, and triangular distribution for onload operations. The table compares costs by type of operation. These comparisons indicate whether large incongruities exist between the models. The comparison also helps determine if using a stochastic model better estimates of the cost advantage by forecasting costs more accurately.

OPERATION/ ASSUMPTION	*ORIGINAL ASSUMPTIONS*	*UNIFORM DISTRIBUTION*	*TRIANGULAR DISTRIBUTION*
ANCHORAGE ONLOAD	*$309,312.09*	*$323,127.27*	*$317,024.80*
VERTREP ONLOAD	*$227,455.47*	*$234,534.48*	*$231,847.80*
ANCHORAGE OFFLOAD	*$355,936.10*	*$364,686.22*	*$361,366.16*
VERTREP OFFLOAD	*$265,040.38*	*$288,794.71*	*$280,281.27*

Table 4.5 Comparison of All Operations and Distributions

This thesis clearly supports the 1992 cost study conclusions: vertreps are more cost effective than anchorage operations for all three models. The expected cost using "perfect information" in the original (deterministic) scenario should provide the lowest cost distribution. Because the deterministic cost is not at the mid-point of the triangular and uniform distribution, expected cost should increase as more variability is introduced. A "uniform distribution" provides a general stochastic environment. Over time, this distribution approaches a normal distribution centered on the range's medium. The larger the range of the distribution, the more inaccurate the information. The triangular distribution provides a stochastic environment, as with a uniform distribution, but it is tailored to the best estimates using experience and observation.

The unexpected result of the various distributions was the difference in costs between anchorage and vertrep offloads. The onload operation costs for each distribution resulted in similar differences for costs, ranging from $81,857 (deterministic model) to $88,593 (uniform model) and $85,177 (triangular model).

However; the offload operations yielded lower cost differences by operation using the more stochastic models. The higher difference was $90,896 (deterministic), compared to $75,892 (uniform) and $81,085 (triangular). This unexpected result occurs because "most likely" variable in the triangular distribution (which is the deterministic value) is at the "worst case" end of the distribution, not the mid-point.

When compared to the 1992 cost study, the thesis shows large differences in total cost, or savings when comparing the operation types, partially due to the increased RSS&I rate. However the primary difference is that this thesis includes all the operation costs; the 1992 cost study focused on the direct RSS&I costs.

Based solely on total costs, vertrep operations are superior to anchorage operations. A shortfall of the cost studies is that the primary cost driver is the RSS&I stabilized rate based on all ordnance station's (nation-wide) overhead costs. A more accurate comparison would use site-specific RSS&I rates. Furthermore, a better way to compare the cost of one operation to another would use the marginal cost of the station's operations, equipment, and capability. The increased workload by additional operations may increase the marginal cost, due to the requirement to increase personnel, equipment, or build additional facilities. Comparing marginal cost would determine whether the preference for one operation over the other depends on the scale of the operation. Furthermore, an operation's success might affect the marginal cost comparison. An increased tempo through more frequent operations could negate the cost benefits. Additional factors not taken into consideration are the "external costs" of safety and security. Chapter V addresses these two issues and their effect on the operations.

V. DISCUSSION OF EXTERNAL COSTS

External costs are defined as the costs not directly attributed to the operation or the base, but whose cost in terms of prevention directly effect the operation and the budget. The two external costs discussed in this chapter are Safety and Security. The cost for prevention is relatively small, the ability to avoid compliance is high, and the impact for failing to comply is minimal, unless an accident or violation occurs. This chapter will discuss the external costs associated with ordnance operations at Seal Beach and Fallbrook.

A. ORDNANCE SAFETY

One of the major concerns when dealing with ordnance is safety. Unfortunately, the safety cost can only be determined by the resulting damage. The underlying regulations for ordnance safety is the NAVSEA OP 5 (Ammunition and Explosive Ashore Safety Regulations for Handling, Storing, Production, Renovation and Shipping). The OP 5 explosive safety policies are intended to safely provide high quality ammunition in sufficient quantity to satisfy fleet and Marine Corps requirements.

> The segregation of material is directed by United Nations Organization (UNO) hazard classification system. This classification system contains nine hazard classes, two of which, Class 1 and Class 6, apply to hazardous materials. Class 1 consists of ammunition and explosives (Department of Transportation (DOT) classes A, B, and C) and blasting agents. Class 6 consists of poisonous substances (Poison B), irritating materials and etiological agents (NAVSEA OP 5, 1994).

The discussion in the preceding chapters dealt primarily with Class 1 ordnance. Class 1 explosives are further divided into seven divisions that indicate the primary characteristic and associated hazards. "These classes and divisions are designated using decimal notation. A Class 1/ Division 1 hazard, for example is designated by 1.1." (NAVSEA OP 5, 1994). Further refinement is indicated by adding a numerical figure in parenthesis to the left of the Class/Division designator. This number indicates the minimum separation distance, in hundreds of feet, needed for protection from debris, fragments, and firebrands when distance alone provides protection. Separation distances are shown for Class 1, Division 1, 2, and 3 hazards; for example, 1.1(18), 1.2(08), or 1.3(06).

The Explosive Safety Quantity Distance (ESQD) has been determined to be a "safe" distance for fragments, but it does not guarantee that no person will be hit at that distance. The ESQD is equivalent to a "safe" speed limit. The 55 mile per hour speed limit is considered the "safe" speed limit. An accident occurring at 55 or 50 mph could still injure or kill the victim, but the proportionate injuries drop from accidents at speeds in excess of 55 mph.

B. SEAL BEACH, SAFETY ISSUES

Seal Beach is surrounded by the communities of Seal Beach and Leisure World on the west, Rossmoor, Los Alamitos and Garden Grove to the north, and Westminister, Huntington Beach and exclusive Huntington Harbour to the east and southeast. A main attraction of the base is the predominate wetlands that host numerous waterfowl and their admirers. The magazines, the wharf and the ordnance anchorage sites each present a unique ESQD with each of these stakeholders.

1. The Magazine Storage Areas

The primary concern in the storage areas for external stakeholders (public safety) is safe storage and handling in the magazine area. The location and the ammunition inventory levels determine ESQD arcs emanating from the magazine area. The OP 5 provides guidance for determining the size of these arcs. The base's ordnance load plan determines the type and amount of ordnance keeping the ESQD on the reservation. However, the ESQD goes up to the boundaries of the reservation: Seal Beach Boulevard, Westminister Boulevard, Bolsa Chica Road, and Edinger Avenue. These roads are all highly traveled routes which increases the potential for liability in an accident.

In addition, the base is currently operating under an exemption for ordnance safety in the "wildlife refuge area." These areas allow civilians to pass into the ordnance ESQD arcs to observe the migration and breeding of various indigenous wildlife, including the least tern and numerous other "endangered" wildfowl.

2. The Wharf Operating Area

The wharf also has distinct operating areas and independent ESQD arcs. The first is the wharf handling area where the boxcars and trucks are unloaded onto and from the wharf. The ESQD arcs are measured in two types of distance requirements. The first is for containerized loads (in boxcars) or areas located without essential personnel. This is referred to as inter-magazine or intra-line distance. The second is for inhabited buildings or public traffic route distances. The minimum distances for firebrand/fragmentation exposure for public traffic routes are based on the traffic levels over a 24 hour period as defined by OP 5. The wharf is restricted primarily by the amount of traffic on Pacific Coast Highway, with more than 5,000 vehicles each day. The minimum firebrand and fragmentation distance is 1080 feet for Class 1/Division 2, Category (18) munitions. The distance from Weapon Station Seal Beach wharf to Pacific Coast Highway (easement) is 1020 feet (AMHAZ, 1981). The inability to close Pacific Coast Highway (PCH) or to restrict any *Net Explosive Weight* (NEW) of 1.2 (18) explosives severely limits Seal Beach's ability to perform its mission. Reducing of NEW limits for category 18 Class 1/Division 2 munitions will not reduce the explosive safety distance requirements. (AMHAZ, 1981)

Additionally, wharf operations are authorized for NEW from 52.7K to 64K lbs Class1/Division 1 explosives depending on the type and specific wharfside operations.

Because the traffic on PCH exceeds 5,000 vehicles per day, the minimum distance for most Class 1/Division 1 munitions with a NEW of 55,000 lbs is 1,520 feet. The waiver to conduct ordnance operations is based on the separation distances required by the NEW. Reducing the NEW limits at the wharf to a "safe" 24K will compromise wharf capability. (AMHAZ, 1981)

3. The Ordnance Anchorage Areas

The wharf area is located on Anaheim Bay. Access is provided through a channel that forms a "T;" the wharf forms the top of the "T." The ordnance barge anchorage areas are on each of the side of the "T" and are accessed through the same channel. The top right side of the "T" continues on to the privately owned community of Huntington Harbour and the Sunset Beach marinas. This channel past the wharf and the ordnance anchorage areas provides the only access route to the sea and back for the over 4,200 small craft berthed at Huntington Harbour and the marinas.

During wharfside explosive operations and when loaded barges are moored at the anchorages along the channel, these small boats transit through the ESQD arcs. Anchorage operations vary in NEW from 2.4K to 100K lbs of Class 1 /Division 1, using prestaged anchorage moorings for the barges. These boats pass through ESQD arcs from 50 to 1000 feet from the origin in the channel, and within 700 feet from the wharf.

To determine the berthing ESQD arcs, the separation distance for barges/ships utilize the formula of $40W^{1/3}$, where W is equal to the NEW lbs (OP 5). These separation distances create a minimum ESQD arc ranging from 400 feet to 1,857 feet for the maximum NEW of 100K. Alternatives examined, and subsequently rejected as not practical during the Ammunition Hazard Board review included:

- Closing Anaheim Bay to small boat traffic during explosive operations at the wharf or when loaded barges are moored at anchorages.

- Reduce the NEW limits at the wharf and anchorages based on separation distance to boat channel. This reduces the limits to 25K Class 1/Distance 1 at the wharf, a high limit of 72K at one anchorage mooring (Oscar 6), and a low limit of 9 lbs at two moorings (A-1 and A-2).

- Cease onload/offload munitions of Class 1/Division 1 and 2, category (18) across the Wharf.

These alternatives would either have an adverse affect on the station's ability to complete its mission or be cost prohibitive.

4. Stakeholder Analysis in a Maximum Explosive Accident

The AMHAZ board reviewed the effects of a maximum explosive accident on the station's ability to carry out its mission. The explosive safety waiver request provided the following information:

> The loss of partial or total wharfside onload and offload capability. Additionally, the loss of exposed assets, on-station personnel and ship's company, a possible loss of life and damage to civilians and their vehicles transiting Pacific Coast Highway and Anaheim Bay channel (AMHAZ, 1981).

This analysis neglected the additional costs to the external stakeholders. A major catastrophe would not be limited to the physical damage to personnel and property. The additional costs involve the adverse publicity, which might move the bordering communities from marginal to non-supportive stakeholders, aggressively pursuing base closure or constraining the base rendering it non-mission capable.

The stakeholders involved with the base can be grouped into six primary groups based on their stakes. The primary groups are:

- Station Personnel (comprised of Military and Civilian workers)
- Government Interests (Congress and Local Agencies)
- Major Commands (Pacific Fleet, NAVORD, and NAVSEA)
- Community (local businesses and communities)
- Special Interests (environmental advocates, surrounding homeowners, and media)
- Competitors (other stations and services providing the same or similar services)

The coalitions among groups are based on their past behavior and how they are likely to react to a major accident. Managing these coalitions involves identifying their potential threat and potential for cooperation. These are rated in a matrix from high to low and form four "types" of stakeholders. Table 5.1 summarizes the relationship and considering the stakeholder's threats to, and cooperation with the NWS Seal Beach.

		Stakeholder's Potential for Threat	
		High	***Low***
Stakeholder's Potential for Cooperation	***High***	Vacillating or Mixed Blessing	Supportive
	Low	Antagonistic	Marginal

Table 5.1 Stakeholder Relationship Descriptions, From Ref (Savage, 1991)

Each of the primary groups is analyzed below, characterizing their relationship to NWS Seal Beach as either cooperative or adversarial and their likely reactions to a major explosive accident.

- **Station Personnel** - As major participants in station operations the station personnel have high potential for cooperation, and low potential as a threat to continued operations. Despite a major catastrophe they would remain supportive stakeholders.

- **Government Interests** - These stakeholders tend to remain on the margin for the normal station operations; however, the potential exists for a rapid shift in attitudes through legislative action (in the case of federal government) or direct intervention at the local level in response to changes in their stakes. In the case of a major accident, the response of the government would be to move from a marginal attitude to an antagonistic one.

- **Major Commands** - The major organizations are either supported by or support the ordnance station and have a vested interest in Seal Beach's continued operations. The attitude in this patriarchal relationship is normally marginal, representing minimal oversight and cooperation. In the event of any accident, the involvement of all the commands would escalate. The escalation of involvement would increase both the threats and the cooperation to the station's operations, vacillating between being helpful and being a hindrance.

- **Community** - The relationship with the local community and businesses are supportive by the investment in the community. An accident would move the community from a "low" threat to a "higher" threat due to the incident. The overall impact on the community from ceasing operations at the base would be negative because of the resulting reduction in investment.

- **Special Interests** - The interest of the various coalitions are normally marginal, maintaining a low cooperative and threat posture on the base's overall operation. The station provides various benefits during "normal" operations. The wildlife advocates support the status quo to prevent encroachment on the dwindling wetlands. The local homeowners and boating enthusiasts see the station as a minimal threat and it prevents further development. Each of these constituents would be mobilized into an aggressive posture as a result of a major accident. The effect on their safety, property, or interests moves the group to vocal and visible action, through another normally disinterested party, the media.

- **Competitors** - The final group of stakeholders is actively involved in the activities of the station. The group benefits from real or perceived shortfalls of the operations. Their high potential both as a threat to take away the station's activities and to cooperate because of mutual benefits, make the competitors a "mixed blessing." Competitors would view a major accident as a competitive advantage, although it might not move them from their original stakeholder posture.

The cost for dealing with each of the stakeholder is based on analyzing their positioning and the strategy to deal with the situation. A strong antagonistic power base will require a more preemptive strategy and force greater participation by the marginal stakeholders.

C. FALLBROOK, SAFETY ISSUES

The Fallbrook detachment is bordered to the north, west and south by Camp Pendleton, and by the communities of Fallbrook and Oceanside on the east and southeast. The relatively unpopulated areas provide Fallbrook with greater leniency in establishing the station's ordnance load plan for its magazines, storage areas, and intermediate-level maintenance facilities. The vertrep site is located 22 miles within the adjacent Camp Pendleton. Camp Pendleton represents the fastest and easiest access seaward; the ability to remain on naval installations reduces exposure to civilians. The final piece of the vertrep operation involves the operation and safety concerns at the Confined Area Landing site (CAL site). This section will describe the safety aspects of the following stages: the magazine area, the transportation routes and handling, and the CAL site.

1. The Magazine Storage Areas

Because the magazine areas are predominately bordered by Camp Pendleton there are minimal external safety concerns. The primary concern at Fallbrook involves the environmental impact of the stored ordnance and wildlife. An example that has continued since the end of the Vietnam War involves storing excess Napalm containers that were never shipped before the war ended. The containers have deteriorated slowly and some have leaked

into the ground. Attempts to destroy or remove the containers have been hampered by both the EPA and Endangered Species Act. The Napalm area is the nesting site for the kangaroo rat and attempts to move the canisters would disturb their habitat. Leaving the canisters incurs fines of up to $6000 dollars per day for any leaking canisters. It is in this environment that concerns for life and property safety must be balanced with the external stakeholders' agendas for nature.

The major safety issue in Fallbrook is the additional double handling of material because of insufficient dock space to properly prepare the ordnance loads. Another point of concern is the lack of a segregation facility to inspect and rebuild the material retrograded from the ships. The additional transportation to Seal Beach for segregation increases the probability of an accident. This leads to the next section discussing transportation safety.

2. The Transportation Routes and Handling

The increased ordnance handling raises the probability of an accident. The goal of the ordnance safety personnel is to minimize the impact of an accident. Where Fallbrook's remote location provides a large expanse of land to safely store and handle ordnance material, that same remote location requires shipping ammunition a long distance to load and offload ships. This transportation is primarily over commercial routes such as Interstate 15 for material to San Diego/North Island, and Interstates 5 and 15 for bases and stations to the north and east. The concern is also increased with the further development of land between Fallbrook and the customers. The migration toward Fallbrook has increased traffic on those highways at a greater rate than the highways can be modified. This situation increases costs for the ordnance stations through longer driving hours, greater restrictions on travel hours and loads, and most importantly the probability of an accident. The cost to the organization will be many fold, primarily in public relations and regulations.

3. Helicopter Operations at the CAL Site

The problem identified with the ESQD arc at Seal Beach is also a factor at Camp Pendleton. The minimum distance for 1.2 (18) is 1800 feet and for Class 1/Division 1 of 30,000 lbs NEW is 1,250 feet (inhabited building distance). CAL Site 20 is currently operating under a waiver due to the distance to Interstate 5, 1180 feet from the pad. The waiver is contingent on building a new $3.3 million helicopter pad south of CAL Site 20 (Milcon P-553 Mtg, 1994). The first quarter of fiscal year 1998 is the earliest date that the new site (LZ Viewpoint) could be built. One of the primary holdups is an environmental analysis of the site. Another concern is potential encroachment into the ESQD. A border patrol checkpoint (San Clemente) is currently located 2½ miles from CAL Site 20. On average, the queue for the checkpoint is from one-quarter mile to two miles long. A new checkpoint has been planned for five years. It will be built 1½ miles north of LZ Viewpoint. The new checkpoint will be expanded from four to in excess of 10 lanes. The additional width of the checkpoint potentially expands the civilians near the ESQD arc.

Upon completing of the new site, the requirement for a waiver becomes moot. The

distance to the interstate exceeds OP 5's requirements for all class and division of ammunition, including 1.2 (18). In addition to the obvious increased safety from the farther distance, the current operations require that a crash-rescue crew be present for airlift operations. The new site will include additional safety factors not present at CAL Site 20, which include water, phones, electricity and lights. The increased capability will reduce the operations cost by reducing personnel at the site, decreasing risk to the public and safety personnel, and providing more flexibility in airframes for vertreps (larger payloads will reduce the time and number of lifts).

4. Stakeholder Analysis in a Maximum Explosive Accident

The AMHAZ Board's review of a maximum explosive accident would consider both the site, personnel, and equipment damaged or killed and the repercussions beyond the base and Fallbrook. The advantages in operation costs and reduced vehicles on the public highways could be negated by a large detonation. The stakeholders in operations at CAL Site 20 are grouped by their philosophies and potential reactions. These groups are explained below:

- Fallbrook Organizations (NOC Fallbrk Det., Marine Corps Programs, civilian and military personnel)
- Camp Pendleton Organizations (Base and Marine Expeditionary Force units)
- Special Interests (environmental advocates, Media, Border Patrol)
- Community and Government (commuters, Highway Patrol, Federal and Local Government, and the local communities of San Clement and Oceanside)
- Major Responsible Commands (Pacific Fleet, NOC, and NAVSEA)
- Competitors (other stations and services providing the same or similar services)

Each of the primary groups is analyzed below including their relationship to the vertrep operation in cooperative or adversarial terms and the likely reactions as a result of a major explosive accident.

- **Fallbrook Organizations** - As was the case at Seal Beach, the station personnel and organizations have high potential for cooperation, and low potential as a threat to continued operations. Despite a major catastrophe they would remain supportive stakeholders.
- **Camp Pendleton Organizations** - Camp Pendleton organizations are supportive of the operations, because the operations support the base's mission, Camp

Pendleton benefits from the opportunity to conduct training in conjunction with the vertrep, proximity provides additional flexibility for supporting the Marine units for deployments and contingency operations, and the expansive area reduces further encroachment by civilian stakeholders into the explosive safety set aside distances. Camp Pendleton stands to lose the most in case of a major accident because all reports will name Camp Pendleton Marine Base as the accident site no matter what organization was conducting the operation.

- **Special Interests** - These stakeholders tend to remain on the margin for the station's normal operations. The benefits of the normal base operations support the various stakeholders. Camp Pendleton is one of the larger environmental reservations along the southern California coast. It is the home to over 23 endangered species, and many more native plants and animals. The border patrol controls the flow of illegal immigrants as they journey north along the one public highway between the 17 mile Camp Pendleton coastline and the Santa Margarita mountain range. Additionally, Marine units conducting training increases the probability of locating and reporting their movements. However, the potential to change rapidly through legislative action (in the case of environmental issues) or direct intervention (by not building a new checkpoint) would elicit movement from the stakeholders. In the case of a major accident, these stakeholders would move from a marginal attitude to an antagonistic one.

- **Community and Government** - The local community and businesses are supportive because of the investment in the community. An accident would move the community from a "low" to a "higher" threat state due to the incident. In the event of a major accident, the immediate impact would delay all traffic along the coast, requiring a four hour rerouting through the base. A worst case scenario would also potentially injure or kill civilians on the highway and/or the train route. Closing a major thoroughfare (Interstate 5) would attract all news agencies from both San Diego and Los Angeles, and likely receive national coverage. The local communities would also be concerned that an accident could happen near the San Onofre nuclear power plant. San Clemente's marginal interest in ordnance operations would escalate rapidly to an aggressive antagonistic atmosphere, creating serious restrictions on future training and ordnance operations.

- **Major Responsible Commands** - As was the case at Seal Beach, the major organizations either are supported by or support the ordnance station and have a vested interest in continuing vertrep operations from Fallbrook via Camp Pendleton. The program's success, lower cost and increased flexibility of operations creates a strong supportive relationship. In the event of any accident, involvement by all the commands would increase. This escalation would increase both the threats and the cooperation to the station's operations, vacillating between being helpful and a hindrance.

- **Competitors** - The final group of stakeholders is actively involved in the activities of the vertrep operations. This group benefits from real or perceived operation shortfalls. Their high potential both as a threat to take away the station's activities and to cooperate because of mutual benefits, makes the competitors a "mixed blessing." Competitors would view a major accident as a competitive advantage, although it might not move them from their original stakeholder posture.

The stakeholder's power base is relatively higher in the event of a major accident. The cost of this needs to be balanced against the probability of an accident while transporting ordnance to Seal Beach for anchorage operations.

D. ORDNANCE SECURITY

The security issues discussed in the following sections deal with the potential locations of security weaknesses in anchorage and vertrep operations, and what alternatives exist to reduce or eliminate these shortcomings.

1. Seal Beach Anchorage Operations

Seal Beach has two areas of security concern during anchorage operations. The ordnance has to pass under a four lane road (Pacific Coast Highway) to reach the wharf area from the main part of the station. The other security concern is the barge anchorage area. This area is a main thoroughfare for commercial traffic to and from the Huntington Harbour and Sunset marinas.

The security issue was addressed in a mock attack on the installation during an exercise. The method was to "attack" the shipment by waiting above the trucks leaving the wharf and dropping "grenades" into the vehicles. An alternative method is modeled after the attack on the Marine Barracks in Beirut or more recently the Oklahoma City bombing. A vehicle could be filled with explosives and then driven through the guard rail and onto the railcars passing underneath. The explosive damage to civilians and property, especially since this point is on a highway and relatively close to nearby houses and businesses, would create a large public relations coup. The physical damage could not be contained within the base and away from the general populace.

The other concern is the "Oscar" anchorage area located to each side of Anaheim Bay channel. This is the mooring area in which the loaded barges are anchored waiting onloading or offloading. The access in this area can not be secured. Any security efforts are passive (telling that an area has been breached) rather than active (physical prevention). In a scenario similar to the one previously described, a small boat loaded with explosives could either self-detonate on the loaded barges or strike the dock area while the crane loads the barges. In either case, it is impossible to secure this area without blocking both ingress and egress into Anaheim Bay. This safety measure was reviewed by NOC, Seal Beach, but rejected as unworkable.

In review, the anchorage operations present relatively easy targets of opportunity to individuals seeking recognition. The safety options are to close both Pacific Coast Highway and block ingress and egress through the bay and channel. This would require substantial support from outside agencies and make the operation less attractive relative to other options.

2. Fallbrook (Camp Pendleton) Vertrep Operations

Fallbrook has one area that is vulnerable to attack during the ordnance operation: the route from Fallbrook to the CAL site passes under Interstate 5. Security for the route is provided by station personnel and the base's Military Police. Although the scenario for a security problem area is similar to Seal Beach, using trucks instead of railcars limits the potential damage and simultaneous explosions. It is likely to involve one vehicle instead of several. This risk would be similar to an attack on an explosive vehicle on any public highway, with the exception that emergency communications and vehicles are already prepared for an accident, speeding the response. In a comparative analysis of the two operations, Fallbrook has lower vulnerability to security breaches.

VI. SUMMARY AND RECOMMENDATIONS

This thesis has answered the research questions posed in the Chapter I. This chapter summarizes how the thesis accomplished this task. This chapter also addresses the thesis' shortfalls. Finally, recommendations are made to further develop the models and the operations in terms of future capability, ability to support fleet requirements, and the cost effectiveness of maintaining the status quo.

A. THE BENEFITS AND COSTS ASSOCIATED BY OPERATION

Vertrep operations are more cost effective than anchorage operations. They also increase flexibility, reduce the frequency of ordnance traveling over the public roads, and provide a more secure operating area. The principle cost driver, helicopter flight hours, is subject to constraints beyond of the control of the Fallbrook personnel. These constraints range from the weather for conducting flight operations, to the maximum flight hours per day, to the amount of lifts that can be handled per day.

An advantage unique to vertrep operations is the ability to conduct the operation following the ship's Pre-deployment Operational Maintenance (POM). The POM is conducted 45 days prior to the deployment. 30 days from deployment, the ship is required to "turn its screws." This period is the prime period to conduct vertrep onload operations. The ability to resupply the ship without tieing up allows ship crew training to continue.

Anchorage operations are not as constrained by visibility, which could limit the length of vertrep operations. Additionally, using LCUs instead of barges for smaller pallets loads in well-decked ships reduces the commercial cost of tugs, barges, and cranes. The concern of these operations (barge and LCU) is the ability to mix incompatible classes of ordnance in large quantities. Although not common, this can increase the probability of a safety violation, resulting in fines (violation of Coast Guard transportation regulations) or a major explosive accident.

The 1992 cost study provided a framework for analyzing anchorage/wharf and vertrep operations. That study found vertrep operations more cost effective for LHA, AE, and CV class ships. LPH and LPD class ships can be onloaded from the wharf eliminating many of the costs.

This thesis primarily benefits the fleet logisticians. The constraints in operational funding mean that the fleet needs to better evaluate how it can optimize its training and support dollars. The models provide a planning tool for estimating single operation costs based on the expected number and class of ships. A triangular distribution model uses the knowledge and experience of cognizant personnel to better approximate the operation costs. Continally modifying the model will improve budget submissions and validate operation costs. "Crystal Ball" allows the user to predict costs by specific area within a range of accuracy. This tool also provides "what if" contingency planning for future BRAC effects on fleet support establishments.

B. THESIS SHORTFALLS

There are numerous shortfalls within the models, some of which are unavoidable and others of which have only become evident during the thesis research. The first shortfall is the inability to answer one of the primary questions of this thesis: the marginal costs determining when an anchorage operation becomes more cost effective than a vertrep operation. Ideally, marginal cost would be measured in terms of pallets. The marginal cost of vertrep operations can be determined using the number of pallets and lifts per day. The 1992 cost study only discussed anchorage operations in terms of days of evolution. The other change since that study is the number of barges stationed in the area, reduced from thirteen to four. This impacts the barge prestaging, the flexibility for one barge to still make the scheduled run to North Island every two weeks, and the length of the operation.

Another shortfall is the use of labor costs. The $13.66 per hour for military personnel is based on the civilian equivalent rate (WG-7, step 2). This rate is based on the average rank of participating personnel (helicopter support teams would contain a senior member on site, a staff sergeant (E-6) and two teams of four members, consisting of one sergeant/corporal and three non-rates (E-1 to E-3). In that same vein, a later study was conducted concerning vertrep savings in 1994. This study used four vertrep operations from calendar year 1991. They included four different ship classes, a CV (carrier), AE (ammunition/explosive), LHA, and LPH. This later study assumes that the "actual labor rate" is 40% of the stabilized rate.

Additionally, the helicopter and fuel cost is estimated at $1300.00 per hour, with 5 helicopters per evolution. The 1994 study determined "vertrep evolutions are more costly then traditional ship onload and offload procedures." The general statement is not correct for all class of ships, evident from this thesis. However, the statement highlights a neglected area of ship's costs.

Time is money, and the amount of time used for getting from point A to B, the length of the evolution, and the beneficial training gained from the evolution have no dollar value in these models. A total cost evaluation for each operation should include the cost of doing business, or the inability to conduct business in terms of steaming hours. The 1994 study identified costs transferred to AirPac for helicopters, but none of the studies have addressed the cost of "steaming."

The last issue concerns the safety of military HST and civilian ordnance personnel in vertrep operations. Both groups possess skills unique to their trade; HST personnel are trained in the hookup and rigging of material and equipment, ordnance personnel have unique knowledge and training in safely handling ammunition and explosives. Handling ordnance requires constant diligence to prevent unsafe conditions. The longer the evolution and the more familiar personnel become with the operation, the more likely personnel are to become complacent. Prior planning to ensure load compatibility is not foolproof, and requires intervention by all personnel involved. The helicopter creates static electricity, which if not grounded properly can conceivably detonate certain ordnance. Because the HST personnel are not familiar with the ordnance peculiarities, the ordnance personnel must maintain extra vigilance to prevent ordnance accidents.

C. RECOMMENDATIONS

Vertreps provide the largest benefit to the fleet in terms of cost, training, and flexibility. As supporting bases close, such as the Long Beach Naval Shipyard, it increases Seal Beach's cost for anchorage. Despite the fact that the cost for wharf operations has only been minimally effected by these closures, expanding use of vertrep evolutions and the appropriate budget funding seems appropriate for other large platform ships.

Another analysis should be conducted to incorporate the lost time for steaming and anchorage. This would support continuing to use of Seal Beach for San Diego homeported ships, even though Port Hadlock and Concord may appear more cost effective in the monetary cost analysis.

The models provide a more accurate analysis for estimating and comparing cost options. However, the model should be modified using the actual costs wherever possible. The inability to access RSS&I direct and indirect costs by station limits this thesis' ability to accurately account for costs. This data can only be provided from within the organization, due to proprietary restraints (although the information was requested).

APPENDIX A. ONLOAD ANCHORAGE MODEL

The appendix for anchorage onload operations consists of four parts; the assumptions, the model's description of costs, the spreadsheet with an average pallet quantity of 1212, and the spreadsheet using the original assumptions and a stochastic pallet count of 490 pallets.

Model Assumptions

Description	Rate	Description	Rate
Stabilized Rate		**Time per Action**	
Stabilized RSS&I Rate per Workhr	$101.93	Days of Evolution (Barge)	8
Sched Cost for Comm Truck	$75.00	Days of Evolution (Crane)	4
Average Cost for Comm Truck	$800.00	Std Work Hours per Evolution Day	8
Commercial Tug Cost	$283.00	**Time per Pallet**	
Floating Crane Cost per Day	$6,000.00	Travel & Setup Time Hrs (Seal Beach)	.4
Crew Size		Travel & Setup Time Hrs (Fallbrook)	.5
Crew Size Load/Unload Truck	2		
Crew Size w/ block & brace (Fallbrk)	3	Dbl Hndlg Trvl Time Hrs (Seal Beach)	.2
Crew Size Station Truck (Driver)	1	Dbl Hndlg Trvl Time Hrs (Fallbrook)	.25
Crew Size Switch Engine (Seal Bch)	2		
Crew Size (Forklift)	5	Loadtime Double Handling (both)	.05
Crew Size (Wharf)	17	Loadtime w/ block & brace (Fallbrook)	.06
# of Other Station Personnel Support	9	Loadtime Railcar (Seal Beach)	.06
Amount of Equipment			
Number of Prep Tugs Support	1	Offload Time (Railcar)	.05
Number of Load/Offload Tugs	2	Offload Time (Detained Truck)	.17
Number of Cleanup Tugs	1		
Percent of Pallets		Hrs per Trip Intra-station (Fallbrook)	.50
Double Handling Percent (Seal Beach)	6%	Hrs per Trip Intra-station Switch Engine	.40
Double Handling Percent (Fallbrook)	35%	Hrs per Trip Intra-station Truck (SB)	.15

Description	Rate	Description	Rate
% Pallets loaded into Railcar (Seal Bch)	95%	Download Time/Barge (N/A)	.33
% Trucks Detained in Yard (Seal Bch)	30%	Travel Time to Anchorage (N/A)	.75
Pallets per Vehicle		Travel Time from Anchorage (N/A)	.75
Prep Ave Plts/Mag/Trip (Seal Bch)	10		
Prep Ave Plts/Mag/Trip (Fallbrook)	8	Other Station Personnel Support Hours	40.50
		Prep Tug Support Hours	36.00
Double Handling Plts/Trucks (Seal Bch)	4	Load/Offload Tug Support Hours	72.00
Double Handling Pallets/Trks(Fallbrk)	10	Cleanup Tug Support Hours	24.00
Average Pallets per Truck (Fallbrook)	20	Ave Pallets per Trk Detained (Seal Bch)	14
Average Pallets per Barge (N/A)	80	Average Pallets per Railcar (Seal Bch)	30

Description of Costs

The costs for the individual areas of the spreadsheet are detailed below.

TITLE OF COST COMPONENT	*DESCRIPTION OF THE COST COMPONENT*
Preparation Cost, Seal Beach	Number of pallets * Est Hours per Pallet Prep (study) * Crew Size(2) * RSS&I Rate
Preparation Cost, Fallbrook	Number of pallets * Est Hours per Pallet Prep (study) * Crew Size(2) * RSS&I Rate
Travel & Setup, Seal Beach	Number of pallets / Prep Ave Plts/Mag/Trip (SB) * Travel & Setup Time Hrs (SB) * Crew Size Load/Unload Trk * RSS&I Rate
Travel & Setup, Fallbrook	Number of plts / Prep Ave Plts/Mag/Trip (Fallbrk)* Travel & Setup Time Hrs (Fallbrk) * Crew Size Load/Unload Trk * RSS&I Rate
Number of Pallets Double Handled	Number of pallets * Double Handling Percent (by location)
Double Handling - (Travel) Costs (Seal Beach)	(Number of Pallets Double Handled *Double Handling Percent (SB)) / Dbl Hndlg Plts per Trks (SB) * Dbl Hndlg Trvl Time Hrs (SB) * Crew Size Load/Unload Trk * RSS&I Rate
Double Handling - (Travel) Costs (Fallbrook)	(Number of Pallets Double Handled *Double Handling Percent (Fallbrk)) / Dbl Hndlg Plts per Trks (Fallbrk) * Dbl Hndlg Trvl Time Hrs (Fallbrk) * Crew Size Load/Unload Trk * RSS&I Rate
Double Handling - (Load) Costs (Seal Beach)	(Number of Pallets Double Handled *Double Handling Percent (SB)) * Loadtime Double Handling (both) * Crew Size Load/Unload Trk * RSS&I Rate
Double Handling - (Load) Costs (Fallbrook)	(Number of Pallets Double Handled *Double Handling Percent (Fallbrk)) * Loadtime Double Handling (both) * Crew Size Load/Unload Trk * RSS&I Rate
Scheduling Cost, Commercial Truck (Fallbrook to Seal Bch)	(Number of Pallets Fallbrook / Average Plts per Truck) * Sched Cost for Comm Truck
Load Conveyance at Fallbrook	Number of Pallets Fallbrook * Loadtime w/ block & brace * Crew Size w/ block & brace * RSS&I Rate
Travel Intra-station Cost (Fallbrk)	(Number of Pallets Fallbrook / Average Plts per Truck) * Hrs per intra-station (Fallbrk) * Crew Size w/ block & brace * RSS&I Rate
Travel Inter-station Cost (Fallbrk)	(Number of Pallets Fallbrook / Average Plts per Truck) * Average Cost for Comm Truck
Number of Pallets - Railcar	Number of Pallets * Percent Pallets loaded into Railcar
Number of Pallets - Detained Trk	Number of Pallets * (1-Percent Pallets loaded into Railcar)
Detained Truck Costs (Seal Beach)	(Number of Pallets Fallbrook / Average Plts per Truck) * % Trucks Detained in Yard * RSS&I

TITLE OF COST COMPONENT	*DESCRIPTION OF THE COST COMPONENT*
Load Conveyance -Railcar	(Number of Pallets * %Pallets loaded into Railcar) * Loadtime Railcar * Crew Size Switch Engine * RSS&I Rate
Travel (Rail) to Wharf (Seal Bch)	(Number of Pallets * %Pallets loaded into Railcar) / Ave Plts per Railcar * Hrs per Trip intra-station Switch Engine * Crew Size Switch Engine * RSS&I Rate
Travel (Truck) to Wharf (Seal Bch)	Number of Pallets * (100% - %Pallets loaded into Railcar) / Ave Plts per Trk Detained * Hrs per Trip intra-station Truck * Crew Size Station Driver * RSS&I Rate
Offload Conveyance - Wharf (Rail)	Number of Pallets Railcar * Offload Time (Railcar) * Crew size (Forklift) * RSS&I Rate
Offload Conveyance - Wharf (Trk)	Number of Pallets Detained Trk * Offload Time (Detained Trk) * Crew size (Forklift) * RSS&I Rate
Preparation Tug Support Cost	Number of Preparation Tugs * Prep Tug Spt Hrs * Commercial Tug Cost
Load/Offload Tug Support Cost	Number of Load/Offload Tugs * Load/Offload Tug Spt Hrs * Commercial Tug Cost
Cleanup Tug Support Cost	Number of Cleanup Tugs * Cleanup Tug Spt Hrs * Commercial Tug Cost
Loading Barge & Ship (Inclusive Costs)	Crew Size (Wharf) * Standard Work Hours per Evolution Day * Days of Evolution (Barge) * RSS&I Rate
Floating Crane Support Cost	Floating Crane Cost per Day * Days of Evolution (Crane)
Personnel Support (Other Station)	Number of Other Station Personnel Spt * Other Station Personnel Spt Hrs * RSS&I Rate
TOTAL COST FOR OPERATION	Summary of All Cost Components

ONLOAD ANCHORAGE OPERATION - SEAL BEACH (LHA)

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk
LFORM	615	20%	123	492
LFORM - 1.2(18)	195	10%	20	176
SHIP'S FILL	80	100%	80	0
EODMU	25	100%	25	0
MISSION ALLOW.	297	100%	297	0
Total Pallets/Costs	1212		545	668

Model Costs - Ave Load (LHA)

Material Type	# of Pallets From SB	# of Pallets From Fallbrk	Est Hrs per Pallet Prep	Prep Cost Seal Beach	Prep Cost Fallbrook	Trvl & Setup Seal Beach	Trvl & Setup Fallbrook
LFORM	123	492	0.22	$5,516.45	$22,065.81	$1,002.99	$6,268.70
LFORM - 1.2(18)	20	176	0.22	$874.56	$7,871.03	$159.01	$2,236.09
SHIP'S FILL	80	0	0.27	$4,403.38	$0.00	$652.35	$0.00
EODMU	25	0	0.32	$1,630.88	$0.00	$203.86	$0.00
MISSION ALLOW.	297	0	0.27	$16,347.53	$0.00	$2,421.86	$0.00
Total Pallets/Costs	545	668		$28,772.80	$29,936.84	$4,440.07	$8,504.78

Material Type	# of Pallets Dbl Hndl (SB)	# of Pallets Dbl Hndl(Flbk)	Dbl Hnd-Trv Seal Beach	Dbl Hnd-Trv Fallbrook	Dbl Hnd-Ld Seal Beach	Dbl Hnd-Ld Fallbrook	Sched Cost Comm Trk(F)	Load Convey at Fallbrook	Tvl Intrastation Costs (Fallbrk)	Trvl Interstation Costs (Fallbrk)
LFORM	7	172	$1,328.96	$3,385.10	$1,328.96	$6,770.19	$1,845.00	$9,026.92	$3,761.22	$19,680.00
LFORM - 1.2(18)	1	61	$210.69	$1,207.49	$210.69	$2,414.98	$658.13	$3,219.97	$1,341.65	$7,020.00
SHIP'S FILL	5	0	$864.37	$0.00	$864.37	$0.00	$0.00	$0.00	$0.00	$0.00
EODMU	2	0	$270.11	$0.00	$270.11	$0.00	$0.00	$0.00	$0.00	$0.00
MISSION ALLOW.	18	0	$3,208.96	$0.00	$3,208.96	$0.00	$0.00	$0.00	$0.00	$0.00
Total Pallets/Costs	33	234	$5,883.09	$4,592.58	$5,883.09	$9,185.17	$2,503.13	$12,246.89	$5,102.87	$26,700.00

Material Type	# of Pallets Railcar	# of Pallets Detain Trk	Detained Trk Costs (SB)	Load Convey Railcar (SB)	Trvl (Rail) to Wharf (SB)	Trvl (Trk) to Wharf (SB)	Offload Conv Wharf (Rail)	Offload Conv Wharf (Trk)
LFORM	584	31	$752.24	$7,146.31	$1,588.07	$33.58	$14,888.15	$2,664.20
LFORM - 1.2(18)	185	10	$268.33	$2,265.90	$503.53	$10.65	$4,720.63	$844.74
SHIP'S FILL	76	4	$0.00	$929.60	$206.58	$4.37	$1,936.67	$346.56
EODMU	24	1	$0.00	$290.50	$64.56	$1.37	$605.21	$108.30
MISSION ALLOW.	282	15	$0.00	$3,451.15	$766.92	$16.22	$7,189.89	$1,286.61
Total Pallets/Costs	1151	61	$1,020.57	$14,083.46	$3,129.66	$66.18	$29,340.55	$5,250.41

Material Type	Prep Tug Spt	Load /Offload Tug Support	Cleanup Tug Support	Loading Barge & Ship (Inclus)	Floating Crane Support	Personnel Spt (other)	***Total Cost for Operation***
LFORM	$5,169.65	$20,678.61	$3,446.44	$56,273.43	$12,178.22	$18,852.63	**$225,651.84**
LFORM - 1.2(18)	$1,639.16	$6,556.63	$1,092.77	$17,842.80	$3,861.39	$5,977.66	**$73,008.49**
SHIP'S FILL	$672.48	$2,689.90	$448.32	$7,320.12	$1,584.16	$2,452.38	**$25,375.59**
EODMU	$210.15	$840.59	$140.10	$2,287.54	$495.05	$766.37	**$8,184.70**
MISSION ALLOW.	$2,496.56	$9,986.26	$1,664.38	$27,175.95	$5,881.19	$9,104.44	**$94,206.87**
Total Pallets/Costs	$10,188.00	$40,752.00	$6,792.00	$110,899.84	$24,000.00	$37,153.49	***$426,427.49***

ONLOAD ANCHORAGE OPERATION - SEAL BEACH (LHA)

ORIGINAL ASSUMPTIONS WITH STOCHASTIC PALLET COUNT

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk
LFORM	249	20%	50	199
LFORM - 1.2(18)	79	10%	8	71
SHIP'S FILL	32	100%	32	0
EODMU	10	100%	10	0
MISSION ALLOW.	120	100%	120	0
Total Pallets/Costs	490		220	270

Model Costs - Ave Load (LHA)

Material Type	# of Pallets From SB	# of Pallets From Fallbrk	Est Hrs per Pallet Prep	Prep Cost Seal Beach	Prep Cost Fallbrook	Trvl & Setup Seal Beach	Trvl & Setup Fallbrook
LFORM	50	199	0.22	$2,233.49	$8,933.96	$406.09	$2,538.06
LFORM - 1.2(18)	8	71	0.22	$354.31	$3,188.78	$64.42	$905.90
SHIP'S FILL	32	0	0.27	$1,761.35	$0.00	$260.94	$0.00
EODMU	10	0	0.32	$652.35	$0.00	$81.54	$0.00
MISSION ALLOW.	120	0	0.27	$6,605.06	$0.00	$978.53	$0.00
Total Pallets/Costs	220	270		$11,606.57	$12,122.74	$1,791.52	$3,443.96

Material Type	# of Pallets Dbl Hndl (SB)	# of Pallets Dbl Hndl(Flbk)	Dbl Hnd-Trv Seal Beach	Dbl Hnd-Trv Fallbrook	Dbl Hnd-Ld Seal Beach	Dbl Hnd-Ld Fallbrook	Sched Cost Comm Trk(F)	Load Convey at Fallbrook	Tvl Intrastation Costs (Fallbrk)	Trvl Interstation Costs (Fallbrk)
LFORM	3	70	$538.07	$1,370.55	$538.07	$2,741.10	$747.00	$3,654.80	$1,522.83	$7,968.00
LFORM - 1.2(18)	0	25	$85.36	$489.19	$85.36	$978.38	$266.63	$1,304.50	$543.54	$2,844.00
SHIP'S FILL	2	0	$345.75	$0.00	$345.75	$0.00	$0.00	$0.00	$0.00	$0.00
EODMU	1	0	$108.05	$0.00	$108.05	$0.00	$0.00	$0.00	$0.00	$0.00
MISSION ALLOW.	7	0	$1,296.55	$0.00	$1,296.55	$0.00	$0.00	$0.00	$0.00	$0.00
Total Pallets/Costs	13	95	$2,373.77	$1,859.74	$2,373.77	$3,719.48	$1,013.63	$4,959.30	$2,066.38	$10,812.00

Material Type	# of Pallets Railcar	# of Pallets Detain Trk	Detained Trk Costs (SB)	Load Convey Railcar (SB)	Trvl (Rail) to Wharf (SB)	Trvl (Trk) to Wharf (SB)	Offload Conv Wharf (Rail)	Offload Conv Wharf (Trk)
LFORM	237	12	$304.57	$2,893.38	$642.97	$13.60	$6,027.89	$1,078.67
LFORM - 1.2(18)	75	4	$108.71	$917.98	$204.00	$4.31	$1,912.46	$342.23
SHIP'S FILL	30	2	$0.00	$371.84	$82.63	$1.75	$774.67	$138.62
EODMU	10	1	$0.00	$116.20	$25.82	$0.55	$242.08	$43.32
MISSION ALLOW.	114	6	$0.00	$1,394.40	$309.87	$6.55	$2,905.01	$519.84
Total Pallets/Costs	466	25	$413.28	$5,693.81	$1,265.29	$26.76	$11,862.10	$2,122.69

Material Type	Prep Tug Spt	Load /Offload Tug Support	Cleanup Tug Support	Loading Barge & Ship (Inclus)	Floating Crane Support	Personnel Spt (other)	***Total Cost for Operation***
LFORM	$5,177.17	$20,708.67	$3,451.44	$56,355.22	$12,195.92	$18,880.04	**$160,921.57**
LFORM - 1.2(18)	$1,642.56	$6,570.22	$1,095.04	$17,879.77	$3,869.39	$5,990.05	**$51,647.06**
SHIP'S FILL	$665.34	$2,661.36	$443.56	$7,242.44	$1,567.35	$2,426.35	**$19,089.68**
EODMU	$207.92	$831.67	$138.61	$2,263.26	$489.80	$758.23	**$6,067.46**
MISSION ALLOW.	$2,495.02	$9,980.08	$1,663.35	$27,159.14	$5,877.55	$9,098.81	**$71,586.32**
Total Pallets/Costs	$10,188.00	$40,752.00	$6,792.00	$110,899.84	$24,000.00	$37,153.49	***$309,312.09***

APPENDIX B. OFFLOAD ANCHORAGE MODEL

The appendix for anchorage offload operations, similar to Appendix A. also consists of four parts; the assumptions, the model's description of costs, the spreadsheet with an average pallet quantity of 1212, and the spreadsheet using the original assumptions and a stochastic pallet count of 490 pallets.

Model Assumptions

Description	Rate	Description	Rate
Stabilized Rate		**Time per Action**	
Stabilized RSS&I Rate per Workhr	$101.93	Days of Evolution (Barge)	8
Sched Cost for Comm Truck	$75.00	Days of Evolution (Crane)	4
Average Cost for Comm Truck	$800.00	Std Work Hours per Evolution Day	8
Commercial Tug Cost	$283.00	**Time per Pallet**	
Floating Crane Cost per Day	$6,000.00	Travel & Setup Time Hrs (Seal Beach)	.4
Tons per Pallet	0.67	Segregation Man-hours per Ton	5.50
Crew Size		Dbl Hndlg Trvl Time Hrs (Seal Beach)	.2
Crew Size Load/Unload Truck	2	Dbl Hndlg Trvl Time Hrs (Fallbrook)	.25
Crew Size w/ block & brace (Fallbrk)	3		
Crew Size Station Truck (Driver)	1	Loadtime Railcar (Seal Beach)	.06
Crew Size Switch Engine (Seal Bch)	2	Loadtime Station Truck (Seal Beach)	.05
Crew Size (Forklift)	5	Loadtime w/ block & brace (Fallbrook)	.06
Crew Size (Wharf)	17	Loadtime at Segregation	.06
# of Other Station Personnel Support	9		
Amount of Equipment		Offload/Receipt Time Segregation/Mag	.05
Number of Prep Tugs Support	1	Receipt Time per Pallet (Fallbrook)	.10
Number of Load/Offload Tugs	2		
Number of Cleanup Tugs	1	Hrs per Trip Intra-station Switch Engine	.40
		Hrs per Trip Wharf - Mag (Truck) (SB)	.25

Description	Rate	Description	Rate
Percent of Pallets		Hrs per Trip Segregation - Mag	.50
Double Handling Percent (Seal Beach)	6%	Hrs per Trip Intra-station from Tran D.	.30
Double Handling Percent (Fallbrook)	35%		
		Download Time/Barge (N/A)	.33
% Pallets loaded into Railcar (Seal Bch)	90%	Travel Time to Anchorage (N/A)	.75
% of Material through Transfer Depot	75%	Travel Time from Anchorage (N/A)	.75
Pallets per Vehicle		Other Station Personnel Support Hours	40.50
Prep Ave Plts/Mag/Trip (Seal Bch)	10	Prep Tug Support Hours	36.00
Prep Ave Plts/Mag/Trip (Fallbrook)	8	Load/Offload Tug Support Hours	72.00
		Cleanup Tug Support Hours	24.00
Ave Pallets per Station Trk (Seal Bch)	14		
Average Pallets per Railcar (Seal Bch)	30	**Pallets per Vehicle**	
Average Pallets Comm Truck	20	Double Handling Plts/Trucks (Seal Bch)	4
Average Pallets per Barge (N/A)	80	Double Handling Pallets/Trks(Fallbrk)	10

Description of Costs

The costs for the individual areas of the spreadsheet are detailed below.

TITLE OF COST COMPONENT	*DESCRIPTION OF THE COST COMPONENT*
Download Tug Support Cost	Number of Download Tugs * Download Tug Spt Hrs * Commercial Tug Cost
Load/Offload Tug Support Cost	Number of Load/Offload Tugs * Load/Offload Tug Spt Hrs * Commercial Tug Cost
Cleanup Tug Support Cost	Number of Cleanup Tugs * Cleanup Tug Spt Hrs * Commercial Tug Cost
Floating Crane Support Cost	Floating Crane Cost per Day * Days of Evolution (Crane)
Personnel Support (Other Station)	Number of Other Station Personnel Spt * Other Station Personnel Spt Hrs * RSS&I Rate
Loading Barge & Ship (Inclusive Costs)	Crew Size (Wharf) * Standard Work Hours per Evolution Day * Days of Evolution (Barge) * RSS&I Rate
Number of Pallets Railcar	Number of Pallets * % Pallets Loaded into Railcar
Number of Pallets Station Truck	Number of Pallets * (100% - % Pallets Loaded into Railcar)
Onload Conveyance - Wharf (Rail)	Number of Pallets Railcar * Load Time (Railcar) * Crew size (Forklift) * RSS&I Rate
Onload Conveyance - Wharf (Trk)	Number of Pallets Station Trk * Load Time (Station Trk) * Crew size (Forklift) * RSS&I Rate
Number of Pallets to Segregation	Number of Pallets * % Pallets to Segregation
Transfer to Segregation (Rail)	(Number of Pallets to Seg / Average Pallets per Railcar)* Hrs per Trip Segregation * Crew Size Switch Engine * RSS&I Rate
Receipt at Segregation	Number of Pallets to Seg * Receipt Time Segregation * Crew Size Unload/Load Station * RSS&I Rate
Segregate	(Number of Pallets to Seg * Tons per Pallet) * Segregation Man-hours per Ton * RSS&I Rate
Load at Segregation	Number of Pallets to Seg * Load Time at Segregation * Crew Size Unload/Load Station * RSS&I Rate
Transfer to Mag from Segregation	(Number of Pallets to Seg / Average Pallets per Railcar)* Hrs per Trip Intrastation Switch Engine * Crew Size Switch Engine * RSS&I Rate
Receipt at Magazine	Number of Pallets to Seg * Receipt Time Magazine * Crew Size Unload/Load Station * RSS&I Rate

TITLE OF COST COMPONENT	*DESCRIPTION OF THE COST COMPONENT*
Number Pallets to Marshall / Magazine Area (Rail)	Number of Pallets (Railcar) - Number of Pallets to Segregation
Number Pallets to Marshall / Magazine Area (Station Trk)	Number of Pallets - Number Pallets to Marshall / Magazine Area (Rail)
Transfer (Rail) to Magazine / Marshall Area	(Number of Pallets to Marshall / Magazine Area (Rail) / Ave Plts per Railcar) * Hrs per Trip intra-station Switch Engine * Crew Size Switch Engine * RSS&I Rate
Transfer (Truck) to Magazine / Marshall Area	(Number of Pallets to Marshall / Magazine Area (Station Trk) / Ave Plts per Trk Detained) * Hrs per Trip intra-station Truck * Crew Size Station Driver * RSS&I Rate
Receipt at Magazine	Number of Pallets to Marshall / Magazine Area (both) * Receipt Time Magazine * Crew Size Unload/Load Station * RSS&I Rate
Scheduling Cost, Commercial Truck (Seal Bch to Fallbrook)	(Number of Pallets Fallbrook / Average Plts per Truck) * Sched Cost for Comm Truck
Load Conveyance for Fallbrook	Number of Pallets Fallbrook * Loadtime w/ block & brace * Crew Size w/ block & brace * RSS&I Rate
Travel & Setup, Seal Beach	(Number of Pallets Fallbrook / Average Plts per Truck) * Travel & Setup Time Hrs (SB) * Crew Size Station Truck * RSS&I Rate
Travel Inter-station Cost (Fallbrk)	(Number of Pallets Fallbrook / Average Plts per Truck) * Average Cost for Comm Truck
Number Plts Rcvd at Trans Depot	Number of Pallets (Fallbrk) * % of Material through Transfer Depot
Receive Material at Transfer Depot	Number Plts Rcvd at Trans Depot * Receipt Time per Pallet (Fallbrk) * Crew Size Unload/Load Station * RSS&I Rate
Load Conveyance at Trans Depot	Number Plts Rcvd at Trans Depot * Loadtime Station Trk * Crew Size Station Truck * RSS&I Rate
Transport Material to Magazines	(Number Plts Rcvd at Trans Depot / Average Plts per Truck) * Hrs per Trip intra-station from Trans Depot * Crew Size Station Driver * RSS&I Rate
Offload Material into Magazines	Number of Pallets (Fallbrook) * Receipt Time Magazine * Crew Size Unload/Load Station * RSS&I Rate
TOTAL COST FOR OPERATION	Summary of All Cost Components

OFFLOAD ANCHORAGE OPERATION - SEAL BEACH (LHA)

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk
LFORM	615	20%	123	492
LFORM - 1.2(18)	195	10%	20	176
SHIP'S FILL	80	100%	80	0
EODMU	25	100%	25	0
MISSION ALLOW.	297	100%	297	0
Total Pallets/Costs	1212		545	668

Model Costs - Ave Load (LHA)

Material Type	# of Pallets Railcar	# of Pallets Station Trk	Download Tug Support	Load /Offload Tug Support	Cleanup Tug Support	Floating Crane Support	Personnel Spt (other)	Loading Barge & Ship	Onload Conv Wharf (Rail)	Onload Conv Wharf (Trk)
LFORM	554	62	$5,169.65	$20,678.61	$3,446.44	$12,178.22	$18,852.63	$56,273.43	$16,925.48	$1,567.17
LFORM - 1.2(18)	176	20	$1,639.16	$6,556.63	$1,092.77	$3,861.39	$5,977.66	$17,842.80	$5,366.61	$496.91
SHIP'S FILL	72	8	$672.48	$2,689.90	$448.32	$1,584.16	$2,452.38	$7,320.12	$2,201.69	$203.86
EODMU	23	3	$210.15	$840.59	$140.10	$495.05	$766.37	$2,287.54	$688.03	$63.71
MISSION ALLOW.	267	30	$2,496.56	$9,986.26	$1,664.38	$5,881.19	$9,104.44	$27,175.95	$8,173.77	$756.83
Total Pallets/Costs	1091	121	$10,188.00	$40,752.00	$6,792.00	$24,000.00	$37,153.49	$110,899.84	$33,355.57	$3,088.48

Material Type	Percent of Plts to Segregation	Number of Plts to Segregation	Transfer to Seg (Rail)	Receipt at Segregation	Segregate	Load at Segregation	Transfer to Mag from Seg	Receipt at Magazine
LFORM	3%	18	$62.69	$188.06	$6,930.04	$225.67	$50.15	$188.06
LFORM - 1.2(18)	3%	6	$19.88	$59.63	$2,197.33	$71.55	$15.90	$59.63
SHIP'S FILL	98%	78	$266.38	$799.13	$29,447.98	$958.96	$213.10	$799.13
EODMU	20%	5	$16.99	$50.97	$1,878.06	$61.16	$13.59	$50.97
MISSION ALLOW.	98%	291	$988.92	$2,966.77	$109,325.64	$3,560.13	$791.14	$2,966.77
Total Pallets/Costs		399	$1,354.85	$4,064.56	$149,779.06	$4,877.47	$1,083.88	$4,064.56

Material Type	# Plts to Marshl/ Mag Area (Rail)	# Plts to Marshl/ Mag Area (Trk)	Trans (Rail) to Mag/Marsl Area	Trans (Trk) to Mag/Marsl Area	Receipt at Magazine	Sched Cost Comm Trk(F)	Load Convey for Fallbrook	Trvl & Setup for Fallbrook	Interstation Transfer Costs
LFORM	535	62	$1,454.34	$25,450.90	$6,080.63	$1,845.00	$9,026.92	$1,002.99	$19,680.00
LFORM - 1.2(18)	170	20	$461.13	$8,069.80	$1,928.01	$658.13	$3,219.97	$357.77	$7,020.00
SHIP'S FILL	0	2	$0.00	$0.00	$16.31	$0.00	$0.00	$0.00	$0.00
EODMU	18	3	$47.57	$832.43	$203.86	$0.00	$0.00	$0.00	$0.00
MISSION ALLOW.	0	6	$0.00	$0.00	$60.55	$0.00	$0.00	$0.00	$0.00
Total Pallets/Costs	722	91	$1,963.04	$34,353.13	$8,289.36	$2,503.13	$12,246.89	$1,360.77	$26,700.00

Material Type	# Plts Rcv'd at Transfer Depot	Receive Material at Trans Depot	Load Convey at Trans Depot	Transport Mtl to Magazines	Offload Matl into Magazines	*Total Cost for Operation*
LFORM	369	$7,522.43	$3,761.22	$805.98	$5,014.96	***$224,381.68***
LFORM - 1.2(18)	132	$2,683.31	$1,341.65	$287.50	$1,788.87	***$73,073.99***
SHIP'S FILL	0	$0.00	$0.00	$0.00	$0.00	***$50,073.89***
EODMU	0	$0.00	$0.00	$0.00	$0.00	***$8,647.11***
MISSION ALLOW.	0	$0.00	$0.00	$0.00	$0.00	***$185,899.31***
Total Pallets/Costs	501	$10,205.74	$5,102.87	$1,093.47	$6,803.83	***$542,075.98***

OFFLOAD ANCHORAGE OPERATION - SEAL BEACH (LHA)

ORIGINAL ASSUMPTIONS WITH STOCHASTIC PALLET COUNT

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk
LFORM	249	20%	50	199
LFORM - 1.2(18)	79	10%	8	71
SHIP'S FILL	32	100%	32	0
EODMU	10	100%	10	0
MISSION ALLOW.	120	100%	120	0
Total Pallets/Costs	490		220	270

Model Costs - Ave Load (LHA)

Material Type	# of Pallets Railcar	# of Pallets Station Trk	Download Tug Support	Load /Offload Tug Support	Cleanup Tug Support	Floating Crane Support	Personnel Spt (other)	Loading Barge & Ship	Onload Conv Wharf (Rail)	Onload Conv Wharf (Trk)
LFORM	224	25	$5,177.17	$20,708.67	$3,451.44	$12,195.92	$18,880.04	$56,355.22	$6,852.75	$634.51
LFORM - 1.2(18)	71	8	$1,642.56	$6,570.22	$1,095.04	$3,869.39	$5,990.05	$17,879.77	$2,174.17	$201.31
SHIP'S FILL	29	3	$665.34	$2,661.36	$443.56	$1,567.35	$2,426.35	$7,242.44	$880.68	$81.54
EODMU	9	1	$207.92	$831.67	$138.61	$489.80	$758.23	$2,263.26	$275.21	$25.48
MISSION ALLOW.	108	12	$2,495.02	$9,980.08	$1,663.35	$5,877.55	$9,098.81	$27,159.14	$3,302.53	$305.79
Total Pallets/Costs	441	49	$10,188.00	$40,752.00	$6,792.00	$24,000.00	$37,153.49	$110,899.84	$13,485.34	$1,248.64

Material Type	Percent of Plts to Segregation	Number of Plts to Segregation	Transfer to Seg (Rail)	Receipt at Segregation	Segregate	Load at Segregation	Transfer to Mag from Seg	Receipt at Magazine
LFORM	3%	7	$25.38	$76.14	$2,805.82	$91.37	$20.30	$76.14
LFORM - 1.2(18)	3%	2	$8.05	$24.16	$890.20	$28.99	$6.44	$24.16
SHIP'S FILL	98%	31	$106.55	$319.65	$11,779.19	$383.58	$85.24	$319.65
EODMU	20%	2	$6.80	$20.39	$751.22	$24.46	$5.44	$20.39
MISSION ALLOW.	98%	118	$399.57	$1,198.70	$44,171.98	$1,438.44	$319.65	$1,198.70
Total Pallets/Costs		161	$546.34	$1,639.03	$60,398.42	$1,966.84	$437.08	$1,639.03

Material Type	# Plts to Marshl/ Mag Area (Rail)	# Plts to Marshl/ Mag Area (Trk)	Trans (Rail) to Mag/Marsl Area	Trans (Trk) to Mag/Marsl Area	Receipt at Magazine	Sched Cost Comm Trk(F)	Load Convey for Fallbrook	Trvl & Setup for Fallbrook	Interstation Transfer Costs
LFORM	217	25	$588.83	$10,304.51	$2,461.92	$747.00	$3,654.80	$406.09	$7,968.00
LFORM - 1.2(18)	69	8	$186.82	$3,269.30	$781.09	$266.63	$1,304.50	$144.94	$2,844.00
SHIP'S FILL	0	1	$0.00	$0.00	$6.52	$0.00	$0.00	$0.00	$0.00
EODMU	7	1	$19.03	$332.97	$81.54	$0.00	$0.00	$0.00	$0.00
MISSION ALLOW.	0	2	$0.00	$0.00	$24.46	$0.00	$0.00	$0.00	$0.00
Total Pallets/Costs	292	37	$794.67	$13,906.79	$3,355.54	$1,013.63	$4,959.30	$551.03	$10,812.00

Material Type	# Plts Rcv'd at Transfer Depot	Receive Material at Trans Depot	Load Convey at Trans Depot	Transport Mtl to Magazines	Offload Matl into Magazines	*Total Cost for Operation*
LFORM	149	$3,045.67	$1,522.83	$326.32	$2,030.45	***$160,407.31***
LFORM - 1.2(18)	53	$1,087.08	$543.54	$116.47	$724.72	***$51,673.60***
SHIP'S FILL	0	$0.00	$0.00	$0.00	$0.00	***$28,969.00***
EODMU	0	$0.00	$0.00	$0.00	$0.00	***$6,252.42***
MISSION ALLOW.	0	$0.00	$0.00	$0.00	$0.00	***$108,633.77***
Total Pallets/Costs	203	$4,132.75	$2,066.38	$442.79	$2,755.17	***$355,936.10***

APPENDIX C. ONLOAD VERTREP MODEL

The appendix for vertrep onload operations, following the same format used in the previous appendices consists of four sections; the assumptions, the model's description of costs, the spreadsheet with an average pallet quantity of 1212, and the spreadsheet using the original assumptions and a stochastic pallet count of 490 pallets.

Model Assumptions

Description	Rate	Description	Rate
Stabilized Rate		**Time per Action**	
Stabilized RSS&I Rate per Workhr	$101.93	Days of Evolution (Helo)	3
Sched Cost for Comm Truck	$75.00	Std Work Hours per Evolution Day	9
Average Cost for Comm Truck	$750.00	Hrs for Base Motors - Prestage	8
Base Motors (CamPen) Trk Cost per Hr	$11.91	Trips to Pad per Day	2
Base Motors Truck Cost per Mile	$0.31	**Time per Pallet**	
Helicopter Operations Cost per Hr	$1,500.00	Travel & Setup Time Hrs (Seal Beach)	.4
Helo Support Team Cost (Military)	$13.66	Travel & Setup Time Hrs (Fallbrook)	.5
Tons per Pallet	0.67		
Lifts per Ton (Onload)	0.8522	Dbl Hndlg Trvl Time Hrs (Seal Beach)	.2
Lifts per Ton (Offload)	0.8925	Dbl Hndlg Trvl Time Hrs (Fallbrook)	.25
Crew Size			
Crew Size Load/Unload Truck	2	Loadtime Double Handling (both)	.05
Crew Size w/ block & brace (Fallbrk)	3	Loadtime w/ Block & Brace (Fallbrook)	.06
Crew Size Station Truck (Driver)	1	Loadtime Station Trk	.05
Crew Size Switch Engine (Seal Bch)	2	Loadtime to Segregation	.06
Crew Size (Pad Offload)	3		
Crew Size (Helo Pad)	5	Offload Time (Comm Truck)	0.05
Helicopter Support Team (Marine/Navy) Personnel	9	Offload Time (Detained Truck)	0.17
Percent of Pallets		Hrs per Trip Intra-station (Fallbrook)	.50
Double Handling Percent (Seal Beach)	6%	Hrs per Trip Intra-station (SB)	.40
Double Handling Percent (Fallbrook)	35%	Hrs per Trip Truck to Pad (Round trip)	1.12

Description	Rate	Description	Rate
Amount of Equipment			
Number of Helicopters	5	Other Station Personnel Support Hours	27.00
Number of Public Works Trks (Fallbrk)	5	Helicopter Operation Hrs per Helo	19
Number of Base Motors Trks (CamPen)	7		
Pallets per Vehicle		Miles to Pad (Round Trip)	46
Prep Ave Plts/Mag/Trip (Seal Bch)	10		
Prep Ave Plts/Mag/Trip (Fallbrook)	8	**Amount per Day (5 Helos)**	
		Average Plts per Day (derived)	404
Double Handling Plts/Trucks (Seal Bch)	4	Average Tons per Day (derived)	269.5
Double Handling Pallets/Trks(Fallbrk)	10	Ave Lifts per Day - Onload (derived)	230
		Ave Lifts per Day - Offload (derived)	240
Average Pallets per Comm Trk (SB)	20		
Ave Plts per Station/Base Motors Truck	20		

Description of Costs

The costs for the individual areas of the spreadsheet are detailed below.

TITLE OF COST COMPONENT	*DESCRIPTION OF THE COST COMPONENT*
Preparation Cost, Seal Beach	Number of pallets * Est Hours per Pallet Prep (study) * Crew Size(2) * RSS&I Rate
Preparation Cost, Fallbrook	Number of pallets * Est Hours per Pallet Prep (study) * Crew Size(2) * RSS&I Rate
Travel & Setup, Seal Beach	Number of pallets / Prep Ave Plts/Mag/Trip (SB) * Travel & Setup Time Hrs (SB) * Crew Size Load/Unload Trk * RSS&I Rate
Travel & Setup, Fallbrook	Number of plts / Prep Ave Plts/Mag/Trip (Fallbrk)* Travel & Setup Time Hrs (Fallbrk) * Crew Size Load/Unload Trk * RSS&I Rate
Number of Pallets Double Handled	Number of pallets * Double Handling Percent (by location)
Double Handling - (Travel) Costs (Seal Beach)	(Number of Pallets Double Handled *Double Handling Percent (SB)) / Dbl Hndlg Plts per Trks (SB) * Dbl Hndlg Trvl Time Hrs (SB) * Crew Size Load/Unload Trk * RSS&I Rate
Double Handling - (Travel) Costs (Fallbrook)	(Number of Pallets Double Handled *Double Handling Percent (Fallbrk)) / Dbl Hndlg Plts per Trks (Fallbrk) * Dbl Hndlg Trvl Time Hrs (Fallbrk) * Crew Size Load/Unload Trk * RSS&I Rate
Double Handling - (Load) Costs (Seal Beach)	(Number of Pallets Double Handled *Double Handling Percent (SB)) * Loadtime Double Handling (both) * Crew Size Load/Unload Trk * RSS&I Rate
Double Handling - (Load) Costs (Fallbrook)	(Number of Pallets Double Handled *Double Handling Percent (Fallbrk)) * Loadtime Double Handling (both) * Crew Size Load/Unload Trk * RSS&I Rate
Scheduling Cost, Commercial Truck (Seal Bch to Fallbrook)	(Number of Pallets Seal Bch / Average Plts per Truck) * Sched Cost for Comm Truck
Load Conveyance at Seal Bch	Number of Pallets Seal Bch * Loadtime w/ block & brace * Crew Size w/ block & brace * RSS&I Rate
Travel Intra-station Cost (Seal Bch)	(Number of Pallets Seal Bch / Average Plts per Truck) * Hrs per trip intra-station (Seal Bch) * Crew Size w/ block & brace * RSS&I
Travel Inter-station Cost (Seal Bch)	(Number of Pallets Seal Bch / Average Plts per Truck) * Average Cost for Comm Truck
Number of Pallets - P.W. Trucks	Number of Pallets * Percent of Pallets loaded on P.W. Trucks
Number of Pallets - Base Mtrs Trks	Number of Pallets * Percent of Pallets loaded on Base Motors Trks
Offload Conv Comm Truck	Number of Pallets Comm Trk * Offload Time (Comm Trk) * Crew Size Load/Unload Trk * RSS&I Rate

TITLE OF COST COMPONENT	*DESCRIPTION OF THE COST COMPONENT*
Travel & Setup Comm Trk	(Number of Pallets (Comm Trk) / Average Plts per Comm Trk) * Travel & Setup Time Hrs (Fallbrk) * Crew Size Load/Unload Trk * RSS&I Rate
Load Conveyance for Pad	Number of Pallets * Loadtime Station Trk * Crew Size Load/Unload Trk * RSS&I Rate
Travel & Setup for Pad	(Number of Pallets / Ave Plts per Station Trk) * Travel & Setup Time Hrs (Fallbrk) * Crew Size Load/Unload Trk * RSS&I Rate
Travel Intrastation (Public Works)	(Number of Pallets P.W. Trucks /Ave Plts per Station Trk) *Hrs per trip intra-station Trk to Pad (Rnd trip) * Crew Size Station Trk * RSS&I Rate
Travel Intrastation (Base Motors)	(Number of Pallets Base Mtrs Trucks /Ave Plts per Station Trk) * Hrs per trip intra-station Trk to Pad (Rnd trip) * Crew Size Station Trk * RSS&I Rate
Offload Conveyance at Pad	Days of Evolution (Helo) * Std Work Hours per Evolution Day * Crew Size (Pad Offload) * RSS&I Rate
Personnel Support (Fallbrook)	Days of Evolution (Helo) * Std Work Hours per Evolution Day * Crew Size (Helo Pad) * RSS&I Rate
Helo Spt Team (Military)	Helicopter Support Team (Marine/Navy) Personnel *Other Station Personnel Support Hours * Helo Support Team Cost (Military)
Helicopter Operation Costs	Number of Helicopters *Helicopter Operation Hrs per Helo * Helicopter Operations Cost per Hr
TOTAL COST FOR OPERATION	Summary of All Cost Components

ONLOAD VERTICAL REPLENISHMENT OPERATION - FALLBROOK (LHA)

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk	# of Total Tonnage	# of Total Helo Lifts
LFORM	615	6%	37	578	412.05	351
LFORM - 1.2(18)	195	0%	0	195	130.65	111
SHIP'S FILL	80	38%	30	50	53.6	46
EODMU	25	30%	8	18	16.75	14
MISSION ALLOW.	297	41%	122	175	198.99	170
Total Pallets/Costs	1212		197	1015	812.04	692

Model Costs - Ave Load (LHA)

Material Type	# of Pallets From SB	# of Pallets From Fallbrk	Est Hrs per Pallet Prep	Prep Cost Seal Beach	Prep Cost Fallbrook	Trvl & Setup Seal Beach	Trvl & Setup Fallbrook
LFORM	37	578	0.22	$1,654.94	$25,927.32	$300.90	$7,365.72
LFORM - 1.2(18)	0	195	0.22	$0.00	$8,745.59	$0.00	$2,484.54
SHIP'S FILL	30	50	0.27	$1,673.28	$2,730.09	$247.89	$631.97
EODMU	8	18	0.32	$489.26	$1,141.62	$61.16	$222.97
MISSION ALLOW.	122	175	0.27	$6,702.49	$9,645.04	$992.96	$2,232.65
Total Pallets/Costs	197	1015		$10,519.97	$48,189.67	$1,602.91	$12,937.85

Material Type	# of Pallets Dbl Hndl (SB)	# of Pallets Dbl Hndl(Flbk)	Dbl Hnd-Trv Seal Beach	Dbl Hnd-Trv Fallbrook	Dbl Hnd-Ld Seal Beach	Dbl Hnd-Ld Fallbrook	Sched Cost Comm Trk (SB)	Load Convey at Seal Beach	Tvl Intrastation Costs (SB)	Trvl Interstation (SB to Fallbrk)
LFORM	2	202	$398.69	$3,977.49	$398.69	$7,954.97	$138.38	$677.02	$225.67	$1,383.75
LFORM - 1.2(18)	0	68	$0.00	$1,341.65	$0.00	$2,683.31	$0.00	$0.00	$0.00	$0.00
SHIP'S FILL	2	17	$328.46	$341.26	$328.46	$682.52	$114.00	$557.76	$185.92	$1,140.00
EODMU	0	6	$81.03	$120.40	$81.03	$240.81	$28.13	$137.61	$45.87	$281.25
MISSION ALLOW.	7	61	$1,315.67	$1,205.63	$1,315.67	$2,411.26	$456.64	$2,234.16	$744.72	$4,566.38
Total Pallets/Costs	12	355	$2,123.86	$6,986.44	$2,123.86	$13,972.88	$737.14	$3,606.55	$1,202.18	$7,371.38

Material Type	# of Pallets Comm Trk	# of Pallets P.W. Trucks	# of Pallets B.Mtrs Trucks	Offload Conv Comm Trk	Trvl & Setup Comm Trk	Load Convey for Pad	Trvl & Setup for Pad	Tvl Intrastation (Public Works)	Tvl Intrastation (Base Motors)	Offload Conv at Pad
LFORM	37	256	359	$376.12	$188.06	$6,268.70	$3,134.35	$1,462.70	$7,776.44	$4,189.47
LFORM - 1.2(18)	0	81	114	$0.00	$0.00	$1,987.64	$993.82	$463.78	$2,524.13	$1,328.37
SHIP'S FILL	30	33	47	$309.87	$154.93	$815.44	$407.72	$190.27	$1,086.00	$544.97
EODMU	8	10	15	$76.45	$38.22	$254.83	$127.41	$59.46	$398.20	$170.30
MISSION ALLOW.	122	124	173	$1,241.20	$620.60	$3,027.32	$1,513.66	$706.37	$3,799.69	$2,023.21
Total Pallets/Costs	197	505	707	$2,003.64	$1,001.82	$12,353.92	$6,176.96	$2,882.58	$15,584.47	$8,256.33

Material Type	Personnel Spt (Fallbrk)	Helo Spt Team (Military)	Helo Ops Costs	***Total Cost for Operation***
LFORM	$6,982.46	$1,684.34	$71,386.37	***$153,852.53***
LFORM - 1.2(18)	$2,213.95	$534.06	$22,634.70	***$47,935.54***
SHIP'S FILL	$908.29	$219.10	$9,286.03	***$22,884.24***
EODMU	$283.84	$68.47	$2,901.88	***$7,310.20***
MISSION ALLOW.	$3,372.02	$813.41	$34,474.39	***$85,415.16***
Total Pallets/Costs	$13,760.55	$3,319.38	$140,683.37	***$317,397.68***

ONLOAD VERTICAL REPLENISHMENT OPERATION - FALLBROOK (LHA)

ORIGINAL ASSUMPTIONS WITH STOCHASTIC PALLET COUNT

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk	# of Total Tonnage	# of Total Helo Lifts
LFORM	249	6%	15	234	166.83	142
LFORM - 1.2(18)	79	0%	0	79	52.93	45
SHIP'S FILL	32	38%	12	20	21.44	18
EODMU	10	30%	3	7	6.7	6
MISSION ALLOW.	120	41%	49	71	80.4	69
Total Pallets/Costs	490		79	411	328.30	280

Model Costs - Ave Load (LHA)

Material Type	# of Pallets From SB	# of Pallets From Fallbrk	Est Hrs per Pallet Prep	Prep Cost Seal Beach	Prep Cost Fallbrook	Trvl & Setup Seal Beach	Trvl & Setup Fallbrook
LFORM	15	234	0.22	$670.05	$10,497.40	$121.83	$2,982.22
LFORM - 1.2(18)	0	79	0.22	$0.00	$3,543.09	$0.00	$1,006.56
SHIP'S FILL	12	20	0.27	$669.31	$1,092.04	$99.16	$252.79
EODMU	3	7	0.32	$195.71	$456.65	$24.46	$89.19
MISSION ALLOW.	49	71	0.27	$2,708.08	$3,896.99	$401.20	$902.08
Total Pallets/Costs	79	411		$4,243.14	$19,486.16	$646.64	$5,232.83

Material Type	# of Pallets Dbl Hndl (SB)	# of Pallets Dbl Hndl(Flbk)	Dbl Hnd-Trv Seal Beach	Dbl Hnd-Trv Fallbrook	Dbl Hnd-Ld Seal Beach	Dbl Hnd-Ld Fallbrook	Sched Cost Comm Trk (SB)	Load Convey at Seal Beach	Tvl Intrastation Costs (SB)	Trvl Interstation (SB to Fallbrk)
LFORM	1	82	$161.42	$1,610.40	$161.42	$3,220.79	$56.03	$274.11	$91.37	$560.25
LFORM - 1.2(18)	0	28	$0.00	$543.54	$0.00	$1,087.08	$0.00	$0.00	$0.00	$0.00
SHIP'S FILL	1	7	$131.38	$136.50	$131.38	$273.01	$45.60	$223.10	$74.37	$456.00
EODMU	0	2	$32.41	$48.16	$32.41	$96.32	$11.25	$55.04	$18.35	$112.50
MISSION ALLOW.	3	25	$531.59	$487.12	$531.59	$974.25	$184.50	$902.69	$300.90	$1,845.00
Total Pallets/Costs	5	144	$856.80	$2,825.73	$856.80	$5,651.46	$297.38	$1,454.95	$484.98	$2,973.75

Material Type	# of Pallets Comm Trk	# of Pallets P.W. Trucks	# of Pallets B.Mtrs Trucks	Offload Conv Comm Trk	Trvl & Setup Comm Trk	Load Convey for Pad	Trvl & Setup for Pad	Tvl Intrastation (Public Works)	Tvl Intrastation (Base Motors)	Offload Conv at Pad
LFORM	15	104	145	$152.28	$76.14	$2,538.06	$1,269.03	$592.21	$3,199.43	$4,195.56
LFORM - 1.2(18)	0	33	46	$0.00	$0.00	$805.25	$402.62	$187.89	$1,073.49	$1,331.12
SHIP'S FILL	12	13	19	$123.95	$61.97	$326.18	$163.09	$76.11	$485.74	$539.19
EODMU	3	4	6	$30.58	$15.29	$101.93	$50.97	$23.78	$210.62	$168.50
MISSION ALLOW.	49	50	70	$501.50	$250.75	$1,223.16	$611.58	$285.40	$1,586.22	$2,021.96
Total Pallets/Costs	79	204	286	$808.30	$404.15	$4,994.57	$2,497.29	$1,165.40	$6,555.50	$8,256.33

Material Type	Personnel Spt (Fallbrk)	Helo Spt Team (Military)	Helo Ops Costs	***Total Cost for Operation***
LFORM	$6,992.61	$1,686.79	$71,490.12	***$112,599.52***
LFORM - 1.2(18)	$2,218.54	$535.17	$22,681.61	***$35,415.96***
SHIP'S FILL	$898.65	$216.78	$9,187.49	***$15,663.77***
EODMU	$280.83	$67.74	$2,871.09	***$4,993.77***
MISSION ALLOW.	$3,369.93	$812.91	$34,453.07	***$58,782.45***
Total Pallets/Costs	$13,760.55	$3,319.38	$140,683.37	***$227,455.47***

APPENDIX D. OFFLOAD VERTREP MODEL

The vertrep offload operations is broken into four sections; the assumptions, the model's description of costs, the spreadsheet with an average pallet quantity of 1212, and the spreadsheet using the original assumptions and a stochastic pallet count of 490 pallets. The model's assumptions are almost identical to those identified in Appendix C, with minor changes representing the unique features of an offload process.

Model Assumptions

Description	Rate	Description	Rate
Stabilized Rate		**Time per Action**	
Stabilized RSS&I Rate per Workhr	$101.93	Days of Evolution (Helo)	3
Sched Cost for Comm Truck	$75.00	Std Work Hours per Evolution Day	9
Average Cost for Comm Truck	$750.00	Hrs for Base Motors - Prestage	4
Base Motors (CamPen) Trk Cost per Hr	$11.91	Trips to Pad per Day	2
Base Motors Truck Cost per Mile	$0.31	**Time per Pallet**	
Helicopter Operations Cost per Hr	$1,500.00	Travel & Setup Time Hrs (Seal Beach)	.4
Helo Support Team Cost (Military)	$13.66	Travel & Setup Time Hrs (Fallbrook)	.5
Tons per Pallet	0.67		
Lifts per Ton (Onload)	0.8522	Dbl Hndlg Trvl Time Hrs (Seal Beach)	.2
Lifts per Ton (Offload)	0.8925	Dbl Hndlg Trvl Time Hrs (Fallbrook)	.25
Crew Size			
Crew Size Load/Unload Truck	2	Loadtime Double Handling (both)	.05
Crew Size w/ block & brace (Fallbrk)	3	Loadtime w/ Block & Brace (Fallbrook)	.06
Crew Size Station Truck (Driver)	1	Loadtime Station Trk	.05
Crew Size Switch Engine (Seal Bch)	2	Loadtime to Segregation	.06
Crew Size (Pad Offload)	3		
Crew Size (Helo Pad)	5	Offload Time (Station Truck)	0.05
Helicopter Support Team (Marine/Navy) Personnel	9	Offload Time (Initial Receiving)	0.17

Description	Rate	Description	Rate
Percent of Pallets		Hrs per Trip Intra-station (Fallbrook)	.50
Double Handling Percent (Seal Beach)	6%	Hrs per Trip Intra-station (Seg to Mag)	.25
Double Handling Percent (Fallbrook)	35%	Hrs per Trip Truck to Pad (Round trip)	1.12
Amount of Equipment		Hrs per Ton - for Segregation	5.50
Number of Helicopters	5	Other Station Personnel Support Hours	27.00
Number of Public Works Trks (Fallbrk)	5	Helicopter Operation Hrs per Helo	20
Number of Base Motors Trks (CamPen)	7		
Pallets per Vehicle		Miles to Pad (Round Trip)	46
Prep Ave Plts/Mag/Trip (Seal Bch)	10		
Prep Ave Plts/Mag/Trip (Fallbrook)	8	**Amount per Day (5 Helos)**	
		Average Plts per Day (derived)	404
Double Handling Plts/Trucks (Seal Bch)	4	Average Tons per Day (derived)	269.5
Double Handling Pallets/Trks(Fallbrk)	10	Ave Lifts per Day - Onload (derived)	230
		Ave Lifts per Day - Offload (derived)	240
Average Pallets per Comm Trk (SB)	20		
Ave Plts per Station/Base Motors Truck	20		

Description of Costs

The costs for the individual areas of the spreadsheet are detailed below.

TITLE OF COST COMPONENT	*DESCRIPTION OF THE COST COMPONENT*
Number of Pallets - P.W. Trucks	Number of Pallets * Percent of Pallets loaded on P.W. Trucks
Number of Pallets - Base Mtrs Trks	Number of Pallets * Percent of Pallets loaded on Base Motors Trks
Personnel Support (Fallbrook)	Days of Evolution (Helo) * Std Work Hours per Evolution Day * Crew Size (Helo Pad) * RSS&I Rate
Helo Spt Team (Military)	Helicopter Support Team (Marine/Navy) Personnel *Other Station Personnel Support Hours * Helo Support Team Cost (Military)
Helicopter Operation Costs	Number of Helicopters *Helicopter Operation Hrs per Helo * Helicopter Operations Cost per Hr
Travel Intrastation (Public Works)	(Number of Pallets P.W. Trucks /Ave Plts per Station Trk) *Hrs per trip intra-station Trk to Pad (Rnd trip) * Crew Size Station Trk * RSS&I Rate
Travel Intrastation (Base Motors)	(Number of Pallets Base Mtrs Trucks /Ave Plts per Station Trk) * Hrs per trip intra-station Trk to Pad (Rnd trip) * Crew Size Station Trk * RSS&I Rate
Number of Pallets to Segregation	Number of Pallets * % Pallets to Segregation
Onload Conveyance for Segregation	Number of Pallets to Seg *Loadtime w/ block & brace *Crew Size w/ block & brace (Fallbrk)* RSS&I Rate
Travel & Setup for Segregation	Number of Pallets to Seg *Travel & Setup Time Hrs (Fallbrook)* Crew size (Pad Offload) * RSS&I Rate
Transfer to Segregation	(Number of Pallets to Seg / Average Pallets per Station Trk) * Hrs per Trip Truck to Pad (Round trip) * Crew Size Station Trk * RSS&I Rate
Receipt at Segregation	Number of Pallets to Seg * Receipt Time Segregation * Crew Size Unload/Load Station * RSS&I Rate
Segregate	(Number of Pallets to Seg * Tons per Pallet) * Segregation Man-hours per Ton * RSS&I Rate
Onload Conveyance at Segregation	Number of Pallets to Seg * Load Time at Segregation * Crew Size Unload/Load Station * RSS&I Rate
# of Pallets from Pad to Magazine	Number of Pallets * Percent Direct to Magazine
Onload Conveyance for Magazine from Pad	# of Pallets from Pad to Magazine * Loadtime w/ block & brace * Crew Size w/ block & brace (Fallbrk)* RSS&I Rate

TITLE OF COST COMPONENT	*DESCRIPTION OF THE COST COMPONENT*
Travel & Setup for Magazine	# of Pallets from Pad to Magazine* Travel & Setup Time Hrs (Fallbrook) * Crew size (Pad Offload) * RSS&I Rate
Receipt at Magazine from Pad	# of Pallets from Pad to Magazine * Offload time (Initial Receiving) * Crew Size Unload/Load Station * RSS&I Rate
Transfer from Segregation to Magazine	(Number of Pallets to Seg /Ave Plts per Station Trk) *Hrs per Trip Intra-station (Seg to Mag) *Crew Size Station Trk * RSS&I Rate
Travel & Setup for Magazine	Number of Pallets to Seg *Travel & Setup Time Hrs (Fallbrook) * Crew Size Station Trk * RSS&I Rate
Receipt at Magazine from Segregation	Number of Pallets to Seg * Receipt Time Magazine * Crew Size Unload/Load Station * RSS&I Rate
TOTAL COST FOR OPERATION	Summary of All Cost Components

OFFLOAD VERTICAL REPLENISHMENT OPERATION - FALLBROOK (LHA)

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk	# of Total Tonnage	# of Total Helo Lifts
LFORM	615	6%	37	578	412.05	351
LFORM - 1.2(18)	195	0%	0	195	130.65	111
SHIP'S FILL	80	38%	30	50	53.6	46
EODMU	25	30%	8	18	16.75	14
MISSION ALLOW.	297	41%	122	175	198.99	170
Total Pallets/Costs	1212		197	1015	812.04	692

Model Costs - Ave Load (LHA)

Material Type	# of Pallets P.W. Trucks	# of Pallets B.Mtrs Trucks	Personnel Spt (Fallbrk)	Helo Spt Team (Military)	Helo Ops Costs	Tvl Intrastation (Public Works)	Tvl Intrastation (Base Motors)
LFORM	256	359	$6,982.46	$1,684.34	$74,418.99	$1,462.70	$7,776.44
LFORM - 1.2(18)	81	114	$2,213.95	$534.06	$23,596.26	$463.78	$2,524.13
SHIP'S FILL	33	47	$908.29	$219.10	$9,680.52	$190.27	$1,086.00
EODMU	10	15	$283.84	$68.47	$3,025.16	$59.46	$398.20
MISSION ALLOW.	124	173	$3,372.02	$813.41	$35,938.93	$706.37	$3,799.69
Total Pallets/Costs	505	707	$13,760.55	$3,319.38	$146,659.86	$2,882.58	$15,584.47

Material Type	Percent to Segregation	# of Pallets to Segregation	Onload Conv for Segregation	Tvl & Setup for Segregation	Transfer to Segregation	Receipt at Segregation	Segregate	Onload Conv at Segregation
LFORM	3%	18	$338.51	$94.03	$47.02	$639.41	$6,930.04	$188.06
LFORM - 1.2(18)	3%	6	$107.33	$29.81	$14.91	$202.74	$2,197.33	$59.63
SHIP'S FILL	98%	78	$1,438.44	$399.57	$199.78	$2,717.05	$29,447.98	$799.13
EODMU	20%	5	$91.74	$25.48	$12.74	$173.28	$1,878.06	$50.97
MISSION ALLOW.	98%	291	$5,340.19	$1,483.39	$741.69	$10,087.03	$109,325.64	$2,966.77
Total Pallets/Costs		399	$7,316.21	$2,032.28	$1,016.14	$13,819.51	$149,779.06	$4,064.56

Material Type	Percent Direct to Magazine	# of Pallets from Pad to Magazine	Onload Convey for Magazine	Tvl & Setup for Magazine	Receipt at Mag from Pad	Transfer from Seg to Mag	Tvl & Setup Seg to Mag	Receipt at Mag from Seg
LFORM	97%	597	$10,945.14	$3,040.32	$20,674.16	$23.51	$94.03	$188.06
LFORM - 1.2(18)	97%	189	$3,470.41	$964.00	$6,555.22	$7.45	$29.81	$59.63
SHIP'S FILL	2%	2	$29.36	$8.15	$55.45	$99.89	$399.57	$799.13
EODMU	80%	20	$366.95	$101.93	$693.12	$6.37	$25.48	$50.97
MISSION ALLOW.	2%	6	$108.98	$30.27	$205.86	$370.85	$1,483.39	$2,966.77
Total Pallets/Costs		813	$14,920.84	$4,144.68	$28,183.81	$508.07	$2,032.28	$4,064.56

Material Type	***Total Cost for Operation***
LFORM	***$135,527.20***
LFORM - 1.2(18)	***$43,030.47***
SHIP'S FILL	***$48,477.67***
EODMU	***$7,312.21***
MISSION ALLOW.	***$179,741.27***
Total Pallets/Costs	***$414,088.83***

OFFLOAD VERTICAL REPLENISHMENT OPERATION - FALLBROOK (LHA)

ORIGINAL ASSUMPTIONS WITH STOCHASTIC PALLET COUNT

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk	# of Total Tonnage	# of Total Helo Lifts
LFORM	249	6%	15	234	166.83	142
LFORM - 1.2(18)	79	0%	0	79	52.93	45
SHIP'S FILL	32	38%	12	20	21.44	18
EODMU	10	30%	3	7	6.7	6
MISSION ALLOW.	120	41%	49	71	80.4	69
Total Pallets/Costs	490		79	411	328.30	280

Model Costs - Ave Load (LHA)

Material Type	# of Pallets P.W. Trucks	# of Pallets B.Mtrs Trucks	Personnel Spt (Fallbrk)	Helo Spt Team (Military)	Helo Ops Costs	Tvl Intrastation (Public Works)	Tvl Intrastation (Base Motors)
LFORM	104	145	$6,992.61	$1,686.79	$74,527.15	$592.21	$3,199.43
LFORM - 1.2(18)	33	46	$2,218.54	$535.17	$23,645.16	$187.89	$1,073.49
SHIP'S FILL	13	19	$898.65	$216.78	$9,577.79	$76.11	$485.74
EODMU	4	6	$280.83	$67.74	$2,993.06	$23.78	$210.62
MISSION ALLOW.	50	70	$3,369.93	$812.91	$35,916.70	$285.40	$1,586.22
Total Pallets/Costs	204	286	$13,760.55	$3,319.38	$146,659.86	$1,165.40	$6,555.50

Material Type	Percent to Segregation	# of Pallets to Segregation	Onload Conv for Segregation	Trvl & Setup for Segregation	Transfer to Segregation	Receipt at Segregation	Segregate	Onload Conv at Segregation
LFORM	3%	7	$137.06	$38.07	$19.04	$258.88	$2,805.82	$76.14
LFORM - 1.2(18)	3%	2	$43.48	$12.08	$6.04	$82.14	$890.20	$24.16
SHIP'S FILL	98%	31	$575.37	$159.83	$79.91	$1,086.82	$11,779.19	$319.65
EODMU	20%	2	$36.69	$10.19	$5.10	$69.31	$751.22	$20.39
MISSION ALLOW.	98%	118	$2,157.65	$599.35	$299.67	$4,075.57	$44,171.98	$1,198.70
Total Pallets/Costs		161	$2,950.26	$819.52	$409.76	$5,572.72	$60,398.42	$1,639.03

Material Type	Percent Direct to Magazine	# of Pallets from Pad to Magazine	Onload Convey for Magazine	Trvl & Setup for Magazine	Receipt at Mag from Pad	Transfer from Seg to Mag	Trvl & Setup Seg to Mag	Receipt at Mag from Seg
LFORM	97%	242	$4,431.45	$1,230.96	$8,370.51	$9.52	$38.07	$76.14
LFORM - 1.2(18)	97%	77	$1,405.96	$390.54	$2,655.70	$3.02	$12.08	$24.16
SHIP'S FILL	2%	1	$11.74	$3.26	$22.18	$39.96	$159.83	$319.65
EODMU	80%	8	$146.78	$40.77	$277.25	$2.55	$10.19	$20.39
MISSION ALLOW.	2%	2	$44.03	$12.23	$83.17	$149.84	$599.35	$1,198.70
Total Pallets/Costs		329	$6,039.96	$1,677.77	$11,408.82	$204.88	$819.52	$1,639.03

Material Type	***Total Cost for Operation***
LFORM	***$104,489.84***
LFORM - 1.2(18)	***$33,209.81***
SHIP'S FILL	***$25,812.45***
EODMU	***$4,966.86***
MISSION ALLOW.	***$96,561.41***
Total Pallets/Costs	***$265,040.38***

APPENDIX E. UNIFORM DISTRIBUTION MODEL

The appendix provides the assumptions and spreadsheet compilations for anchorage and vertrep operations using a uniform distribution. The range for the distribution was provided by personnel familiar with the operation features and evolution times.

Model Assumptions for Anchorage Onload Operation

Description	Low	Static Amt	High
Stabilized Rate			
Stabilized RSS&I Rate per Workhr		$101.93	
Sched Cost for Comm Truck		$75.00	
Average Cost for Comm Truck		$800.00	
Commercial Tug Cost		$283.00	
Floating Crane Cost per Day		$6,000.00	
Crew Size			
Crew Size Load/Unload Truck		2	
Crew Size w/ block & brace (Fallbrk)		3	
Crew Size Station Truck (Driver)		1	
Crew Size Switch Engine (Seal Bch)		2	
Crew Size (Forklift)		5	
Crew Size (Wharf)		17	
# of Other Station Personnel Support		9	
Amount of Equipment			
Number of Prep Tugs Support		1	
Number of Load/Offload Tugs		2	
Number of Cleanup Tugs		1	
Percent of Pallets			
Double Handling Percent (Seal Beach)	4%		10%
Double Handling Percent (Fallbrook)	20%		50%

Description	Low	Static Amt	High
% Pallets loaded into Railcar (Seal Bch)	60%		98%
% Trucks Detained in Yard (Seal Bch)	20%		40%
Pallets per Vehicle			
Prep Ave Plts/Mag/Trip (Seal Bch)	6		12
Prep Ave Plts/Mag/Trip (Fallbrook)	6		12
Double Handling Plts/Trucks (Seal Bch)	2		12
Double Handling Pallets/Trks(Fallbrk)	2		20
Ave Pallets per Trk Detained (Seal Bch)	8		20
Average Pallets per Railcar (Seal Bch)	20		40
Average Pallets per Truck (Fallbrook)	3		26
Average Pallets per Barge (N/A)	20		120
Time per Action			
Days of Evolution (Barge)		8	
Days of Evolution (Crane)		4	
Std Work Hours per Evolution Day	8		10
Time per Pallet			
Travel & Setup Time Hrs (Seal Beach)	.2		1.0
Travel & Setup Time Hrs (Fallbrook)	.2		1.0
Dbl Hndlg Trvl Time Hrs (Seal Beach)	.18		.22
Dbl Hndlg Trvl Time Hrs (Fallbrook)	.23		.28
Loadtime Double Handling (both)	.04		.06
Loadtime w/ Block & Brace (Fallbrook)	.05		.07
Loadtime Railcar (Seal Beach)	.05		.06

Description	Low	Static Amt	High
Offload Time (Railcar)	.05		.08
Offload Time (Detained Truck)	.17		.25
Hrs per Trip Intra-station (Fallbrook)	.12		.50
Hrs per Trip Intra-station Switch Engine	.40		.50
Hrs per Trip Intra-station Truck (SB)	.15		.40
Download Time/Barge (N/A)		.33	
Travel Time to Anchorage (N/A)		.75	
Travel Time from Anchorage (N/A)		.75	
Other Station Personnel Support Hours		40.50	
Prep Tug Support Hours	36.00		38.00
Load/Offload Tug Support Hours	72.00		74.00
Cleanup Tug Support Hours	24.00		26.00

ONLOAD ANCHORAGE OPERATION - SEAL BEACH (LHA)

UNIFORM DISTRIBUTION MODEL

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk
LFORM	249	20%	50	199
LFORM - 1.2(18)	79	10%	8	71
SHIP'S FILL	32	100%	32	0
EODMU	10	100%	10	0
MISSION ALLOW.	120	100%	120	0
Total Pallets/Costs	490		220	270

Model Costs - Ave Load (LHA)

Material Type	# of Pallets From SB	# of Pallets From Fallbrk	Est Hrs per Pallet Prep	Prep Cost Seal Beach	Prep Cost Fallbrook	Trvl & Setup Seal Beach	Trvl & Setup Fallbrook
LFORM	50	199	0.22	$2,233.49	$8,933.96	$667.45	$2,663.69
LFORM - 1.2(18)	8	71	0.22	$354.31	$3,188.78	$105.88	$950.74
SHIP'S FILL	32	0	0.27	$1,761.35	$0.00	$428.88	$0.00
EODMU	10	0	0.32	$652.35	$0.00	$134.03	$0.00
MISSION ALLOW.	120	0	0.27	$6,605.06	$0.00	$1,608.31	$0.00
Total Pallets/Costs	220	270		$11,606.57	$12,122.74	$2,944.54	$3,614.43

Material Type	# of Pallets Dbl Hndl (SB)	# of Pallets Dbl Hndl(Flbk)	Dbl Hnd-Trv Seal Beach	Dbl Hnd-Trv Fallbrook	Dbl Hnd-Ld Seal Beach	Dbl Hnd-Ld Fallbrook	Sched Cost Comm Trk(F)	Load Convey at Fallbrook	Trvl Intrastation Costs (Fallbrk)	Trvl Interstation Costs (Fallbrk)
LFORM	4	69	$307.48	$1,253.48	$516.26	$2,601.96	$1,030.93	$3,658.44	$1,275.40	$10,996.60
LFORM - 1.2(18)	1	25	$48.78	$447.40	$81.90	$928.71	$367.97	$1,305.80	$455.23	$3,924.99
SHIP'S FILL	2	0	$197.58	$0.00	$331.73	$0.00	$0.00	$0.00	$0.00	$0.00
EODMU	1	0	$61.74	$0.00	$103.67	$0.00	$0.00	$0.00	$0.00	$0.00
MISSION ALLOW.	8	0	$740.92	$0.00	$1,244.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total Pallets/Costs	15	94	$1,356.50	$1,700.88	$2,277.55	$3,530.68	$1,398.90	$4,964.24	$1,730.63	$14,921.59

Material Type	# of Pallets Railcar	# of Pallets Detain Trk	Detained Trk Costs (SB)	Load Convey Railcar (SB)	Trvl (Rail) to Wharf (SB)	Trvl (Trk) to Wharf (SB)	Offload Conv Wharf (Rail)	Offload Conv Wharf (Trk)
LFORM	195	54	$420.85	$2,264.35	$601.35	$108.18	$6,224.04	$5,780.90
LFORM - 1.2(18)	62	17	$150.21	$718.41	$190.79	$34.32	$1,974.70	$1,834.10
SHIP'S FILL	25	7	$0.00	$291.00	$77.28	$13.90	$799.88	$742.93
EODMU	8	2	$0.00	$90.94	$24.15	$4.34	$249.96	$232.16
MISSION ALLOW.	94	26	$0.00	$1,091.25	$289.81	$52.14	$2,999.54	$2,785.97
Total Pallets/Costs	384	106	$571.06	$4,455.95	$1,183.38	$212.89	$12,248.11	$11,376.06

Material Type	Prep Tug Spt	Load /Offload Tug Support	Cleanup Tug Support	Loading Barge & Ship (Inclus)	Floating Crane Support	Personnel Spt (other)	***Total Cost for Operation***
LFORM	$5,324.48	$20,989.30	$3,595.31	$56,355.22	$12,195.92	$18,880.04	**$168,879.08**
LFORM - 1.2(18)	$1,689.29	$6,659.26	$1,140.68	$17,879.77	$3,869.39	$5,990.05	**$54,291.45**
SHIP'S FILL	$684.27	$2,697.42	$462.05	$7,242.44	$1,567.35	$2,426.35	**$19,724.41**
EODMU	$213.83	$842.94	$144.39	$2,263.26	$489.80	$758.23	**$6,265.81**
MISSION ALLOW.	$2,566.01	$10,115.33	$1,732.68	$27,159.14	$5,877.55	$9,098.81	**$73,966.52**
Total Pallets/Costs	$10,477.89	$41,304.25	$7,075.10	$110,899.84	$24,000.00	$37,153.49	***$323,127.27***

Spreadsheet of Anchorage Onload Operation

Model Assumptions for Anchorage Offload Operation

Description	Low	Static Amt	High
Stabilized Rate			
Stabilized RSS&I Rate per Workhr		$101.93	
Sched Cost for Comm Truck		$75.00	
Average Cost for Comm Truck		$800.00	
Commercial Tug Cost		$283.00	
Floating Crane Cost per Day		$6,000.00	
Tons per Pallet		0.67	
Crew Size			
Crew Size Load/Unload Truck		2	
Crew Size w/ block & brace (Fallbrk)		3	
Crew Size Station Truck (Driver)		1	
Crew Size Switch Engine (Seal Bch)		2	
Crew Size (Forklift)		5	
Crew Size (Wharf)		17	
# of Other Station Personnel Support		9	
Amount of Equipment			
Number of Prep Tugs Support		1	
Number of Load/Offload Tugs		2	
Number of Cleanup Tugs		1	
Percent of Pallets			
% Pallets loaded into Railcar (Seal Bch)	75%		92%
% of Material through Transfer Depot	65%		85%
Pallets per Vehicle			
Ave Pallets per Station Trk (Seal Bch)	8		20
Average Pallets per Railcar (Seal Bch)	20		40
Average Pallets Comm Truck	3		26

Description	Low	Static Amt	High
Time per Action			
Days of Evolution (Barge)		8	
Days of Evolution (Crane)		4	
Std Work Hours per Evolution Day	8		10
Time per Pallet			
Travel & Setup Time Hrs (Seal Beach)	.20		1.00
Segregation Man-hours per Ton		5.50	
Loadtime Railcar (Seal Beach)	.05		.06
Loadtime Station Truck (Seal Beach)	.04		.06
Loadtime w/ block & brace (Fallbrook)	.05		.07
Loadtime at Segregation	.04		.06
Offload/Receipt Time Segregation/Mag	.05		.07
Receipt Time per Pallet (Fallbrook)	.10		.25
Hrs per Trip Intra-station Switch Engine	.40		.50
Hrs per Trip Wharf - Mag (Truck) (SB)	.25		.75
Hrs per Trip Segregation - Mag	.50		.75
Hrs per Trip Intra-station from Tran D.	.12		.50

OFFLOAD ANCHORAGE OPERATION - SEAL BEACH (LHA)

UNIFORM DISTRIBUTION MODEL

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk
LFORM	249	20%	50	199
LFORM - 1.2(18)	79	10%	8	71
SHIP'S FILL	32	100%	32	0
EODMU	10	100%	10	0
MISSION ALLOW.	120	100%	120	0
Total Pallets/Costs	490		220	270

Model Costs - Ave Load (LHA)

Material Type	# of Pallets Railcar	# of Pallets Station Trk	Download Tug Support	Load /Offload Tug Support	Cleanup Tug Support	Floating Crane Support	Personnel Spt (other)	Loading Barge & Ship	Onload Conv Wharf (Rail)	Onload Conv Wharf (Trk)
LFORM	208	41	$5,321.18	$20,995.29	$3,599.21	$12,195.92	$18,880.04	$56,355.22	$6,050.50	$1,033.00
LFORM - 1.2(18)	66	13	$1,688.25	$6,661.16	$1,141.92	$3,869.39	$5,990.05	$17,879.77	$1,919.64	$327.74
SHIP'S FILL	27	5	$683.85	$2,698.19	$462.55	$1,567.35	$2,426.35	$7,242.44	$777.57	$132.76
EODMU	8	2	$213.70	$843.18	$144.55	$489.80	$758.23	$2,263.26	$242.99	$41.49
MISSION ALLOW.	100	20	$2,564.43	$10,118.21	$1,734.56	$5,877.55	$9,098.81	$27,159.14	$2,915.90	$497.83
Total Pallets/Costs	410	80	$10,471.40	$41,316.03	$7,082.78	$24,000.00	$37,153.49	$110,899.84	$11,906.60	$2,032.82

Material Type	Percent of Plts to Segregation	Number of Plts to Segregation	Transfer to Seg (Rail)	Receipt at Segregation	Segregate	Load at Segregation	Transfer to Mag from Seg	Receipt at Magazine
LFORM	3%	7	$32.09	$87.55	$2,805.82	$75.96	$22.98	$87.55
LFORM - 1.2(18)	3%	2	$10.18	$27.78	$890.20	$24.10	$7.29	$27.78
SHIP'S FILL	98%	31	$134.71	$367.55	$11,779.19	$318.91	$96.49	$367.55
EODMU	20%	2	$8.59	$23.44	$751.22	$20.34	$6.15	$23.44
MISSION ALLOW.	98%	118	$505.16	$1,378.33	$44,171.98	$1,195.90	$361.84	$1,378.33
Total Pallets/Costs		161	$690.73	$1,884.65	$60,398.42	$1,635.21	$494.77	$1,884.65

Material Type	# Plts to Marshl/ Mag Area (Rail)	# Plts to Marshl/ Mag Area (Trk)	Trans (Rail) to Mag/Marsl Area	Trans (Trk) to Mag/Marsl Area	Receipt at Magazine	Sched Cost Comm Trk(F)	Load Convey for Fallbrook	Trvl & Setup for Fallbrook	Interstation Transfer Costs
LFORM	201	41	$618.03	$9,652.11	$2,830.84	$1,019.67	$3,658.04	$834.63	$10,876.44
LFORM - 1.2(18)	64	13	$196.08	$3,062.32	$898.14	$363.95	$1,305.65	$297.90	$3,882.10
SHIP'S FILL	0	1	$0.00	$0.00	$7.50	$0.00	$0.00	$0.00	$0.00
EODMU	6	2	$19.59	$305.94	$93.76	$0.00	$0.00	$0.00	$0.00
MISSION ALLOW.	0	2	$0.00	$0.00	$28.13	$0.00	$0.00	$0.00	$0.00
Total Pallets/Costs	271	58	$833.70	$13,020.37	$3,858.38	$1,383.61	$4,963.69	$1,132.54	$14,758.54

Material Type	# Plts Rcv'd at Transfer Depot	Receive Material at Trans Depot	Load Convey at Trans Depot	Transport Mtl to Magazines	Offload Matl into Magazines	*Total Cost for Operation*
LFORM	149	$5,311.72	$1,513.16	$335.39	$2,334.72	***$166,527.06***
LFORM - 1.2(18)	53	$1,895.90	$540.09	$119.71	$833.33	***$53,860.40***
SHIP'S FILL	0	$0.00	$0.00	$0.00	$0.00	***$29,062.96***
EODMU	0	$0.00	$0.00	$0.00	$0.00	***$6,249.69***
MISSION ALLOW.	0	$0.00	$0.00	$0.00	$0.00	***$108,986.11***
Total Pallets/Costs	202	$7,207.62	$2,053.24	$455.10	$3,168.04	***$364,686.22***

Model Assumptions for Vertrep Onload Operation

Description	Low	Static Amt	High
Stabilized Rate			
Stabilized RSS&I Rate per Workhr		$101.93	
Sched Cost for Comm Truck		$75.00	
Average Cost for Comm Truck		$750.00	
Base Motors (CamPen) Trk Cost per Hr		$11.91	
Base Motors Truck Cost per Mile		$0.31	
Helicopter Operations Cost per Hr		$1,500.00	
Helo Support Team Cost (Military)		$13.66	
Tons per Pallet		0.67	
Lifts per Ton (Onload)		0.8522	
Lifts per Ton (Offload)		0.8925	
Crew Size			
Crew Size Load/Unload Truck		2	
Crew Size w/ block & brace (Fallbrk)		3	
Crew Size Station Truck (Driver)		1	
Crew Size Switch Engine (Seal Bch)		2	
Crew Size (Pad Offload)		3	
Crew Size (Helo Pad)		5	
Helicopter Support Team (Marine/Navy) Personnel		9	
Percent of Pallets			
Double Handling Percent (Seal Beach)	4%		10%
Double Handling Percent (Fallbrook)	20%		50%
Amount of Equipment			
Number of Helicopters		5	
Number of Public Works Trks (Fallbrk)		5	
Number of Base Motors Trks (CamPen)		7	

Description	Low	Static Amt	High
Pallets per Vehicle			
Prep Ave Plts/Mag/Trip (Seal Bch)	6		12
Prep Ave Plts/Mag/Trip (Fallbrook)	6		12
Double Handling Plts/Trucks (Seal Bch)	2		12
Double Handling Pallets/Trks(Fallbrk)	2		20
Average Pallets per Comm Trk (SB)	3		26
Ave Plts per Station/Base Motors Truck	8		26
Time per Action			
Days of Evolution (Helo)	2.5		3.5
Std Work Hours per Evolution Day	9		10
Hrs for Base Motors - Prestage			
Trips to Pad per Day	2		2.5
Time per Pallet			
Travel & Setup Time Hrs (Seal Beach)	.2		1.0
Travel & Setup Time Hrs (Fallbrook)	.2		1.0
Dbl Hndlg Trvl Time Hrs (Seal Beach)	.18		.22
Dbl Hndlg Trvl Time Hrs (Fallbrook)	.23		.28
Loadtime Double Handling (both)	.04		.06
Loadtime w/ Block & Brace (Fallbrook)	.05		.07
Loadtime Station Trk	.04		.06
Loadtime to Segregation	.04		.75

Description	Low	Static Amt	High
Offload Time (Comm Truck)	.04		.06
Offload Time (Detained Truck)	.17		.25
Hrs per Trip Intra-station (Fallbrook)	.12		.50
Hrs per Trip Intra-station (SB)	.15		.50
Hrs per Trip Truck to Pad (Round trip)	1.08		2.00
Other Station Personnel Support Hours		27.00	
Helicopter Operation Hrs per Helo		19	
Miles to Pad (Round Trip)	46		60

ONLOAD VERTICAL REPLENISHMENT OPERATION - FALLBROOK (LHA)

UNIFORM DISTRIBUTION MODEL

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk	# of Total Tonnage	# of Total Helo Lifts
LFORM	249	6%	15	234	166.83	142
LFORM - 1.2(18)	79	0%	0	79	52.93	45
SHIP'S FILL	32	38%	12	20	21.44	18
EODMU	10	30%	3	7	6.7	6
MISSION ALLOW.	120	41%	49	71	80.4	69
Total Pallets/Costs	490		79	411	328.30	280

Model Costs - Ave Load (LHA)

Material Type	# of Pallets From SB	# of Pallets From Fallbrk	Est Hrs per Pallet Prep	Prep Cost Seal Beach	Prep Cost Fallbrook	Trvl & Setup Seal Beach	Trvl & Setup Fallbrook
LFORM	15	234	0.22	$670.05	$10,497.40	$205.37	$3,192.94
LFORM - 1.2(18)	0	79	0.22	$0.00	$3,543.09	$0.00	$1,077.68
SHIP'S FILL	12	20	0.27	$669.31	$1,092.04	$167.16	$270.65
EODMU	3	7	0.32	$195.71	$456.65	$41.24	$95.49
MISSION ALLOW.	49	71	0.27	$2,708.08	$3,896.99	$676.32	$965.82
Total Pallets/Costs	79	411		$4,243.14	$19,486.16	$1,090.09	$5,602.59

Material Type	# of Pallets Dbl Hndl (SB)	# of Pallets Dbl Hndl(Flbk)	Dbl Hnd-Trv Seal Beach	Dbl Hnd-Trv Fallbrook	Dbl Hnd-Ld Seal Beach	Dbl Hnd-Ld Fallbrook	Sched Cost Comm Trk (SB)	Load Convey at Seal Beach	Tvl Intrastation Costs (SB)	Trvl Interstation (SB to Fallbrk)
LFORM	1	82	$94.93	$1,475.71	$156.85	$3,076.03	$76.88	$274.11	$101.54	$768.79
LFORM - 1.2(18)	0	28	$0.00	$498.08	$0.00	$1,038.22	$0.00	$0.00	$0.00	$0.00
SHIP'S FILL	1	7	$77.26	$125.09	$127.66	$260.74	$62.57	$223.11	$82.65	$625.74
EODMU	0	2	$19.06	$44.13	$31.50	$91.99	$15.44	$55.04	$20.39	$154.38
MISSION ALLOW.	4	25	$312.60	$446.38	$516.53	$930.46	$253.18	$902.70	$334.39	$2,531.77
Total Pallets/Costs	6	145	$503.85	$2,589.40	$832.54	$5,397.44	$408.07	$1,454.96	$538.97	$4,080.67

Material Type	# of Pallets Comm Trk	# of Pallets P.W. Trucks	# of Pallets B.Mtrs Trucks	Offload Conv Comm Trk	Trvl & Setup Comm Trk	Load Convey for Pad	Trvl & Setup for Pad	Tvl Intrastation (Public Works)	Tvl Intrastation (Base Motors)	Offload Conv at Pad
LFORM	15	104	145	$144.98	$125.60	$2,405.67	$1,795.32	$963.14	$4,605.08	$4,409.43
LFORM - 1.2(18)	0	33	46	$0.00	$0.00	$763.25	$569.60	$305.57	$1,536.42	$1,398.98
SHIP'S FILL	12	13	19	$118.00	$102.22	$309.16	$230.72	$123.78	$688.03	$566.67
EODMU	3	4	6	$29.11	$25.22	$96.61	$72.10	$38.68	$290.91	$177.09
MISSION ALLOW.	49	50	70	$477.43	$413.61	$1,159.36	$865.21	$464.16	$2,276.51	$2,125.03
Total Pallets/Costs	79	204	286	$769.52	$666.65	$4,734.06	$3,532.95	$1,895.34	$9,396.96	$8,677.19

Material Type	Personnel Spt (Fallbrk)	Helo Spt Team (Military)	Helo Ops Costs	***Total Cost for Operation***
LFORM	$7,349.05	$1,772.77	$71,490.12	***$115,651.75***
LFORM - 1.2(18)	$2,331.63	$562.44	$22,681.61	***$36,306.57***
SHIP'S FILL	$944.46	$227.83	$9,187.49	***$16,282.33***
EODMU	$295.14	$71.20	$2,871.09	***$5,188.16***
MISSION ALLOW.	$3,541.71	$854.35	$34,453.07	***$61,105.67***
Total Pallets/Costs	$14,461.98	$3,488.58	$140,683.37	***$234,534.48***

Spreadsheet of Vertrep Onload Operation

Model Assumptions for Vertrep Offload Operation

Description	Low	Static Amt	High
Stabilized Rate			
Stabilized RSS&I Rate per Workhr		$101.93	
Sched Cost for Comm Truck		$75.00	
Average Cost for Comm Truck		$750.00	
Base Motors (CamPen) Trk Cost per Hr		$11.91	
Base Motors Truck Cost per Mile		$0.31	
Helicopter Operations Cost per Hr		$1,500.00	
Helo Support Team Cost (Military)		$13.66	
Tons per Pallet		0.67	
Lifts per Ton (Onload)		0.8522	
Lifts per Ton (Offload)		0.8925	
Crew Size			
Crew Size Load/Unload Truck		2	
Crew Size w/ block & brace (Fallbrk)		3	
Crew Size Station Truck (Driver)		1	
Crew Size Switch Engine (Seal Bch)		2	
Crew Size (Pad Offload)		3	
Crew Size (Helo Pad)		5	
Helicopter Support Team (Marine/Navy) Personnel		9	
Percent of Pallets			
Double Handling Percent (Seal Beach)	4%		10%
Double Handling Percent (Fallbrook)	20%		50%
Amount of Equipment			
Number of Helicopters		5	
Number of Public Works Trks (Fallbrk)		5	
Number of Base Motors Trks (CamPen)		7	

Description	Low	Static Amt	High
Pallets per Vehicle			
Prep Ave Plts/Mag/Trip (Seal Bch)	6		12
Prep Ave Plts/Mag/Trip (Fallbrook)	6		12
Double Handling Plts/Trucks (Seal Bch)	2		12
Double Handling Pallets/Trks(Fallbrk)	2		20
Average Pallets per Comm Trk (SB)	3		26
Ave Plts per Station/Base Motors Truck	8		26
Time per Action			
Days of Evolution (Helo)	2.5		3.5
Std Work Hours per Evolution Day	9		10
Hrs for Base Motors - Prestage		4	
Trips to Pad per Day	2		2.5
Time per Pallet			
Travel & Setup Time Hrs (Seal Beach)	.2		1.0
Travel & Setup Time Hrs (Fallbrook)	.2		1.0
Dbl Hndlg Trvl Time Hrs (Seal Beach)	.18		.22
Dbl Hndlg Trvl Time Hrs (Fallbrook)	.23		.28
Loadtime Double Handling (both)	.04		.06
Loadtime w/ Block & Brace (Fallbrook)	.05		.07
Loadtime Station Trk	.04		.06
Loadtime to Segregation	.04		.75
Miles to Pad (Round Trip)	46		60

Description	Low	Static Amt	High
Offload Time (Station Truck)	.04		.06
Offload Time (Initial Receiving)	.12		.25
Hrs per Trip Intra-station (Fallbrook)	.45		.55
Hrs per Trip Intra-station (Seg to Mag)	.15		.40
Hrs per Trip Truck to Pad (Round trip)	1.08		2.00
Hrs per Ton - for Segregation		5.50	
Other Station Personnel Support Hours		27.00	
Helicopter Operation Hrs per Helo		20	

OFFLOAD VERTICAL REPLENISHMENT OPERATION - FALLBROOK (LHA)

UNIFORM DISTRIBUTION MODEL

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk	# of Total Tonnage	# of Total Helo Lifts
LFORM	249	6%	15	234	166.83	142
LFORM - 1.2(18)	79	0%	0	79	52.93	45
SHIP'S FILL	32	38%	12	20	21.44	18
EODMU	10	30%	3	7	6.7	6
MISSION ALLOW.	120	41%	49	71	80.4	69
Total Pallets/Costs	490		79	411	328.30	280

Model Costs - Ave Load (LHA)

Material Type	# of Pallets P.W. Trucks	# of Pallets B.Mtrs Trucks	Personnel Spt (Fallbrk)	Helo Spt Team (Military)	Helo Ops Costs	Tvl Intrastation (Public Works)	Tvl Intrastation (Base Motors)
LFORM	104	145	$7,385.98	$1,781.68	$74,527.15	$972.54	$4,649.30
LFORM - 1.2(18)	33	46	$2,343.34	$565.27	$23,645.16	$308.56	$1,550.58
SHIP'S FILL	13	19	$949.20	$228.97	$9,577.79	$124.99	$693.88
EODMU	4	6	$296.63	$71.55	$2,993.06	$39.06	$292.87
MISSION ALLOW.	50	70	$3,559.51	$858.64	$35,916.70	$468.69	$2,297.92
Total Pallets/Costs	204	286	$14,534.66	$3,506.12	$146,659.86	$1,913.83	$9,484.55

Material Type	Percent to Segregation	# of Pallets to Segregation	Onload Conv for Segregation	Trvl & Setup for Segregation	Transfer to Segregation	Receipt at Segregation	Segregate	Onload Conv at Segregation
LFORM	3%	7	$897.39	$54.35	$22.59	$279.63	$2,805.82	$71.96
LFORM - 1.2(18)	3%	2	$284.71	$17.24	$7.17	$88.72	$890.20	$22.83
SHIP'S FILL	98%	31	$3,767.36	$228.17	$94.85	$1,173.94	$11,779.19	$302.11
EODMU	20%	2	$240.27	$14.55	$6.05	$74.87	$751.22	$19.27
MISSION ALLOW.	98%	118	$14,127.60	$855.65	$355.67	$4,402.26	$44,171.98	$1,132.90
Total Pallets/Costs		161	$19,317.32	$1,169.97	$486.33	$6,019.42	$60,398.42	$1,549.07

Material Type	Percent Direct to Magazine	# of Pallets from Pad to Magazine	Onload Convey for Magazine	Trvl & Setup for Magazine	Receipt at Mag from Pad	Transfer from Seg to Mag	Trvl & Setup Seg to Mag	Receipt at Mag from Seg
LFORM	97%	242	$4,429.31	$1,757.36	$9,041.48	$12.47	$54.35	$72.53
LFORM - 1.2(18)	97%	77	$1,405.28	$557.55	$2,868.58	$3.96	$17.24	$23.01
SHIP'S FILL	2%	1	$11.74	$4.66	$23.96	$52.34	$228.17	$304.47
EODMU	80%	8	$146.71	$58.21	$299.47	$3.34	$14.55	$19.42
MISSION ALLOW.	2%	2	$44.01	$17.46	$89.84	$196.28	$855.65	$1,141.77
Total Pallets/Costs		329	$6,037.05	$2,395.24	$12,323.33	$268.38	$1,169.97	$1,561.19

Material Type	***Total Cost for Operation***
LFORM	***$108,815.90***
LFORM - 1.2(18)	***$34,599.42***
SHIP'S FILL	***$29,545.77***
EODMU	***$5,341.08***
MISSION ALLOW.	***$110,492.53***
Total Pallets/Costs	***$288,794.71***

APPENDIX F. TRIANGULAR DISTRIBUTION MODEL

The appendix provides the assumptions and spreadsheet compilations for anchorage and vertrep operations using a uniform distribution. The range for the distribution was provided by personnel familiar with the operation features and evolution times.

Model Assumptions for Anchorage Onload Operation

Description	Low	Most Likely	High
Stabilized Rate			
Stabilized RSS&I Rate per Workhr		$101.93	
Sched Cost for Comm Truck		$75.00	
Average Cost for Comm Truck		$800.00	
Commercial Tug Cost		$283.00	
Floating Crane Cost per Day		$6,000.00	
Crew Size			
Crew Size Load/Unload Truck		2	
Crew Size w/ block & brace (Fallbrk)		3	
Crew Size Station Truck (Driver)		1	
Crew Size Switch Engine (Seal Bch)		2	
Crew Size (Forklift)		5	
Crew Size (Wharf)		17	
# of Other Station Personnel Support		9	
Amount of Equipment			
Number of Prep Tugs Support		1	
Number of Load/Offload Tugs		2	
Number of Cleanup Tugs		1	
Percent of Pallets			
Double Handling Percent (Seal Beach)	4%	6%	10%
Double Handling Percent (Fallbrook)	20%	35%	50%

Description	Low	Most Likely	High
% Pallets loaded into Railcar (Seal Bch)	60%	95%	98%
% Trucks Detained in Yard (Seal Bch)	20%	30%	40%
Pallets per Vehicle			
Prep Ave Plts/Mag/Trip (Seal Bch)	6	10	12
Prep Ave Plts/Mag/Trip (Fallbrook)	6	8	12
Double Handling Plts/Trucks (Seal Bch)	2	4	12
Double Handling Pallets/Trks(Fallbrk)	2	10	20
Ave Pallets per Trk Detained (Seal Bch)	8	14	20
Average Pallets per Railcar (Seal Bch)	20	30	40
Average Pallets per Truck (Fallbrook)	3	20	26
Average Pallets per Barge (N/A)	20	80	120
Time per Action			
Days of Evolution (Barge)		8	
Days of Evolution (Crane)		4	
Std Work Hours per Evolution Day	8	8	10
Time per Pallet			
Travel & Setup Time Hrs (Seal Beach)	.2	.4	1.0
Travel & Setup Time Hrs (Fallbrook)	.2	.5	1.0
Dbl Hndlg Trvl Time Hrs (Seal Beach)	.18	.2	.22
Dbl Hndlg Trvl Time Hrs (Fallbrook)	.23	.25	.28
Loadtime Double Handling (both)	.04	.05	.06
Loadtime w/ Block & Brace (Fallbrook)	.05	.06	.07
Loadtime Railcar (Seal Beach)	.05	.06	.06

Description	Low	Most Likely	High
Offload Time (Railcar)	.05	.05	.08
Offload Time (Detained Truck)	.17	.17	.25
Hrs per Trip Intra-station (Fallbrook)	.12	.50	.50
Hrs per Trip Intra-station Switch Engine	.40	.40	.50
Hrs per Trip Intra-station Truck (SB)	.15	.15	.40
Download Time/Barge (N/A)		.33	
Travel Time to Anchorage (N/A)		.75	
Travel Time from Anchorage (N/A)		.75	
Other Station Personnel Support Hours		40.50	
Prep Tug Support Hours	36.00	36.00	38.00
Load/Offload Tug Support Hours	72.00	72.00	74.00
Cleanup Tug Support Hours	24.00	24.00	26.00

ONLOAD ANCHORAGE OPERATION - SEAL BEACH (LHA)

TRIANGULAR DISTRIBUTION MODEL

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk
LFORM	249	20%	50	199
LFORM - 1.2(18)	79	10%	8	71
SHIP'S FILL	32	100%	32	0
EODMU	10	100%	10	0
MISSION ALLOW.	120	100%	120	0
Total Pallets/Costs	490		220	270

Model Costs - Ave Load (LHA)

Material Type	# of Pallets From SB	# of Pallets From Fallbrk	Est Hrs per Pallet Prep	Prep Cost Seal Beach	Prep Cost Fallbrook	Trvl & Setup Seal Beach	Trvl & Setup Fallbrook
LFORM	50	199	0.22	$2,233.49	$8,933.96	$574.63	$2,629.80
LFORM - 1.2(18)	8	71	0.22	$354.31	$3,188.78	$91.16	$938.65
SHIP'S FILL	32	0	0.27	$1,761.35	$0.00	$369.24	$0.00
EODMU	10	0	0.32	$652.35	$0.00	$115.39	$0.00
MISSION ALLOW.	120	0	0.27	$6,605.06	$0.00	$1,384.65	$0.00
Total Pallets/Costs	220	270		$11,606.57	$12,122.74	$2,535.07	$3,568.44

Material Type	# of Pallets Dbl Hndl (SB)	# of Pallets Dbl Hndl(Flbk)	Dbl Hnd-Trv Seal Beach	Dbl Hnd-Trv Fallbrook	Dbl Hnd-Ld Seal Beach	Dbl Hnd-Ld Fallbrook	Sched Cost Comm Trk(F)	Load Convey at Fallbrook	Tvl Intrastation Costs (Fallbrk)	Trvl Interstation Costs (Fallbrk)
LFORM	3	70	$368.65	$1,274.26	$539.94	$2,734.94	$906.99	$3,652.20	$1,395.05	$9,674.61
LFORM - 1.2(18)	1	25	$58.48	$454.82	$85.65	$976.17	$323.73	$1,303.57	$497.93	$3,453.14
SHIP'S FILL	2	0	$236.88	$0.00	$346.95	$0.00	$0.00	$0.00	$0.00	$0.00
EODMU	1	0	$74.03	$0.00	$108.42	$0.00	$0.00	$0.00	$0.00	$0.00
MISSION ALLOW.	8	0	$888.30	$0.00	$1,301.05	$0.00	$0.00	$0.00	$0.00	$0.00
Total Pallets/Costs	15	95	$1,626.33	$1,729.08	$2,382.01	$3,711.11	$1,230.73	$4,955.77	$1,892.98	$13,127.75

Material Type	# of Pallets Railcar	# of Pallets Detain Trk	Detained Trk Costs (SB)	Load Convey Railcar (SB)	Trvl (Rail) to Wharf (SB)	Trvl (Trk) to Wharf (SB)	Offload Conv Wharf (Rail)	Offload Conv Wharf (Trk)
LFORM	210	39	$368.77	$2,485.61	$623.14	$66.22	$6,256.67	$3,907.91
LFORM - 1.2(18)	67	12	$131.62	$788.61	$197.70	$21.01	$1,985.05	$1,239.86
SHIP'S FILL	27	5	$0.00	$319.44	$80.08	$8.51	$804.07	$502.22
EODMU	8	2	$0.00	$99.82	$25.03	$2.66	$251.27	$156.94
MISSION ALLOW.	101	19	$0.00	$1,197.88	$300.31	$31.91	$3,015.26	$1,883.33
Total Pallets/Costs	414	76	$500.40	$4,891.36	$1,226.26	$130.30	$12,312.32	$7,690.26

Material Type	Prep Tug Spt	Load /Offload Tug Support	Cleanup Tug Support	Loading Barge & Ship (Inclus)	Floating Crane Support	Personnel Spt (other)	***Total Cost for Operation***
LFORM	$5,177.17	$20,708.67	$3,451.44	$56,355.22	$12,195.92	$18,880.04	**$165,395.28**
LFORM - 1.2(18)	$1,642.56	$6,570.22	$1,095.04	$17,879.77	$3,869.39	$5,990.05	**$53,137.26**
SHIP'S FILL	$665.34	$2,661.36	$443.56	$7,242.44	$1,567.35	$2,426.35	**$19,435.13**
EODMU	$207.92	$831.67	$138.61	$2,263.26	$489.80	$758.23	**$6,175.41**
MISSION ALLOW.	$2,495.02	$9,980.08	$1,663.35	$27,159.14	$5,877.55	$9,098.81	**$72,881.73**
Total Pallets/Costs	$10,188.00	$40,752.00	$6,792.00	$110,899.84	$24,000.00	$37,153.49	***$317,024.80***

Model Assumptions for Anchorage Offload Operation

Description	Low	Most Likely	High
Stabilized Rate			
Stabilized RSS&I Rate per Workhr		$101.93	
Sched Cost for Comm Truck		$75.00	
Average Cost for Comm Truck		$800.00	
Commercial Tug Cost		$283.00	
Floating Crane Cost per Day		$6,000.00	
Tons per Pallet		0.67	
Crew Size			
Crew Size Load/Unload Truck		2	
Crew Size w/ block & brace (Fallbrk)		3	
Crew Size Station Truck (Driver)		1	
Crew Size Switch Engine (Seal Bch)		2	
Crew Size (Forklift)		5	
Crew Size (Wharf)		17	
# of Other Station Personnel Support		9	
Amount of Equipment			
Number of Prep Tugs Support		1	
Number of Load/Offload Tugs		2	
Number of Cleanup Tugs		1	
Percent of Pallets			
% Pallets loaded into Railcar (Seal Bch)	75%	90%	92%
% of Material through Transfer Depot	65%	75%	85%
Pallets per Vehicle			
Ave Pallets per Station Trk (Seal Bch)	8	14	20
Average Pallets per Railcar (Seal Bch)	20	30	40
Average Pallets Comm Truck	3	20	26

Description	Low	Most Likely	High
Time per Action			
Days of Evolution (Barge)		8	
Days of Evolution (Crane)		4	
Std Work Hours per Evolution Day	8	8	10
Time per Pallet			
Travel & Setup Time Hrs (Seal Beach)	.20	.4	1.00
Segregation Man-hours per Ton		5.50	
Loadtime Railcar (Seal Beach)	.05	.06	.06
Loadtime Station Truck (Seal Beach)	.04	.05	.06
Loadtime w/ block & brace (Fallbrook)	.05	.06	.07
Loadtime at Segregation	.04	.06	.06
Offload/Receipt Time Segregation/Mag	.05	.05	.07
Receipt Time per Pallet (Fallbrook)	.10	.10	.25
Hrs per Trip Intra-station Switch Engine	.40	.40	.50
Hrs per Trip Wharf - Mag (Truck) (SB)	.25	.25	.75
Hrs per Trip Segregation - Mag	.50	.50	.75
Hrs per Trip Intra-station from Tran D.	.12	.30	.50

OFFLOAD ANCHORAGE OPERATION - SEAL BEACH (LHA)

TRIANGULAR DISTRIBUTION MODEL

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk
LFORM	249	20%	50	199
LFORM - 1.2(18)	79	10%	8	71
SHIP'S FILL	32	100%	32	0
EODMU	10	100%	10	0
MISSION ALLOW.	120	100%	120	0
Total Pallets/Costs	490		220	270

Model Costs - Ave Load (LHA)

Material Type	# of Pallets Railcar	# of Pallets Station Trk	Download Tug Support	Load /Offload Tug Support	Cleanup Tug Support	Floating Crane Support	Personnel Spt (other)	Loading Barge & Ship	Onload Conv Wharf (Rail)	Onload Conv Wharf (Trk)
LFORM	214	35	$5,272.98	$20,898.36	$3,550.70	$12,195.92	$18,880.04	$56,355.22	$6,313.95	$898.74
LFORM - 1.2(18)	68	11	$1,672.95	$6,630.40	$1,126.53	$3,869.39	$5,990.05	$17,879.77	$2,003.22	$285.14
SHIP'S FILL	27	5	$677.65	$2,685.73	$456.32	$1,567.35	$2,426.35	$7,242.44	$811.43	$115.50
EODMU	9	1	$211.77	$839.29	$142.60	$489.80	$758.23	$2,263.26	$253.57	$36.09
MISSION ALLOW.	103	17	$2,541.20	$10,071.50	$1,711.18	$5,877.55	$9,098.81	$27,159.14	$3,042.87	$433.13
Total Pallets/Costs	420	70	$10,376.55	$41,125.30	$6,987.33	$24,000.00	$37,153.49	$110,899.84	$12,425.05	$1,768.60

Material Type	Percent of Plts to Segregation	Number of Plts to Segregation	Transfer to Seg (Rail)	Receipt at Segregation	Segregate	Load at Segregation	Transfer to Mag from Seg	Receipt at Magazine
LFORM	3%	7	$29.81	$83.84	$2,805.82	$81.09	$22.06	$83.84
LFORM - 1.2(18)	3%	2	$9.46	$26.60	$890.20	$25.73	$7.00	$26.60
SHIP'S FILL	98%	31	$125.14	$351.95	$11,779.19	$340.42	$92.63	$351.95
EODMU	20%	2	$7.98	$22.45	$751.22	$21.71	$5.91	$22.45
MISSION ALLOW.	98%	118	$469.27	$1,319.82	$44,171.98	$1,276.58	$347.35	$1,319.82
Total Pallets/Costs		161	$641.66	$1,804.66	$60,398.42	$1,745.53	$474.95	$1,804.66

Material Type	# Plts to Marshl/ Mag Area (Rail)	# Plts to Marshl/ Mag Area (Trk)	Trans (Rail) to Mag/Marsl Area	Trans (Trk) to Mag/Marsl Area	Receipt at Magazine	Sched Cost Comm Trk(F)	Load Convey for Fallbrook	Trvl & Setup for Fallbrook	Interstation Transfer Costs
LFORM	206	35	$609.01	$9,865.48	$2,710.69	$906.77	$3,655.51	$657.92	$9,672.23
LFORM - 1.2(18)	65	11	$193.22	$3,130.01	$860.02	$323.65	$1,304.75	$234.83	$3,452.29
SHIP'S FILL	0	1	$0.00	$0.00	$7.18	$0.00	$0.00	$0.00	$0.00
EODMU	7	1	$19.44	$314.86	$89.78	$0.00	$0.00	$0.00	$0.00
MISSION ALLOW.	0	2	$0.00	$0.00	$26.94	$0.00	$0.00	$0.00	$0.00
Total Pallets/Costs	278	51	$821.66	$13,310.35	$3,694.61	$1,230.42	$4,960.26	$892.75	$13,124.52

Material Type	# Plts Rcv'd at Transfer Depot	Receive Material at Trans Depot	Load Convey at Trans Depot	Transport Mtl to Magazines	Offload Matl into Magazines	*Total Cost for Operation*
LFORM	149	$4,558.07	$1,515.97	$331.59	$2,235.62	***$164,191.24***
LFORM - 1.2(18)	53	$1,626.90	$541.09	$118.35	$797.95	***$53,026.12***
SHIP'S FILL	0	$0.00	$0.00	$0.00	$0.00	***$29,031.24***
EODMU	0	$0.00	$0.00	$0.00	$0.00	***$6,250.41***
MISSION ALLOW.	0	$0.00	$0.00	$0.00	$0.00	***$108,867.15***
Total Pallets/Costs	202	$6,184.98	$2,057.06	$449.95	$3,033.57	***$361,366.16***

Model Assumptions for Vertrep Onload Operation

Description	Low	Most Likely	High
Stabilized Rate			
Stabilized RSS&I Rate per Workhr		$101.93	
Sched Cost for Comm Truck		$75.00	
Average Cost for Comm Truck		$750.00	
Base Motors (CamPen) Trk Cost per Hr		$11.91	
Base Motors Truck Cost per Mile		$0.31	
Helicopter Operations Cost per Hr		$1,500.00	
Helo Support Team Cost (Military)		$13.66	
Tons per Pallet		0.67	
Lifts per Ton (Onload)		0.8522	
Lifts per Ton (Offload)		0.8925	
Crew Size			
Crew Size Load/Unload Truck		2	
Crew Size w/ block & brace (Fallbrk)		3	
Crew Size Station Truck (Driver)		1	
Crew Size Switch Engine (Seal Bch)		2	
Crew Size (Pad Offload)		3	
Crew Size (Helo Pad)		5	
Helicopter Support Team (Marine/Navy) Personnel		9	
Percent of Pallets			
Double Handling Percent (Seal Beach)	4%	6%	10%
Double Handling Percent (Fallbrook)	20%	35%	50%
Amount of Equipment			
Number of Helicopters		5	
Number of Public Works Trks (Fallbrk)		5	
Number of Base Motors Trks (CamPen)		7	

Description	Low	Most Likely	High
Pallets per Vehicle			
Prep Ave Plts/Mag/Trip (Seal Bch)	6	10	12
Prep Ave Plts/Mag/Trip (Fallbrook)	6	8	12
Double Handling Plts/Trucks (Seal Bch)	2	4	12
Double Handling Pallets/Trks(Fallbrk)	2	10	20
Average Pallets per Comm Trk (SB)	3	20	26
Ave Plts per Station/Base Motors Truck	8	20	26
Time per Action			
Days of Evolution (Helo)	2.5	3	3.5
Std Work Hours per Evolution Day	9	9	10
Hrs for Base Motors - Prestage		8	
Trips to Pad per Day	2	2	2.5
Time per Pallet			
Travel & Setup Time Hrs (Seal Beach)	.2	.4	1.0
Travel & Setup Time Hrs (Fallbrook)	.2	.5	1.0
Dbl Hndlg Trvl Time Hrs (Seal Beach)	.18	.2	.22
Dbl Hndlg Trvl Time Hrs (Fallbrook)	.23	.25	.28
Loadtime Double Handling (both)	.04	.05	.06
Loadtime w/ Block & Brace (Fallbrook)	.05	.06	.07
Loadtime Station Trk	.04	.05	.06
Loadtime to Segregation	.04	.06	.75

Description	Low	Most Likely	High
Offload Time (Comm Truck)	.04	0.05	.06
Offload Time (Detained Truck)	.17	0.17	.25
Hrs per Trip Intra-station (Fallbrook)	.12	.50	.50
Hrs per Trip Intra-station (SB)	.15	.40	.50
Hrs per Trip Truck to Pad (Round trip)	1.08	1.12	2.00
Other Station Personnel Support Hours		27.00	
Helicopter Operation Hrs per Helo		19	
Miles to Pad (Round Trip)	46	46	60

ONLOAD VERTICAL REPLENISHMENT OPERATION - FALLBROOK (LHA)

TRIANGULAR DISTRIBUTION MODEL

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk	# of Total Tonnage	# of Total Helo Lifts
LFORM	249	6%	15	234	166.83	142
LFORM - 1.2(18)	79	0%	0	79	52.93	45
SHIP'S FILL	32	38%	12	20	21.44	18
EODMU	10	30%	3	7	6.7	6
MISSION ALLOW.	120	41%	49	71	80.4	69
Total Pallets/Costs	490		79	411	328.30	280

Model Costs - Ave Load (LHA)

Material Type	# of Pallets From SB	# of Pallets From Fallbrk	Est Hrs per Pallet Prep	Prep Cost Seal Beach	Prep Cost Fallbrook	Trvl & Setup Seal Beach	Trvl & Setup Fallbrook
LFORM	15	234	0.22	$670.05	$10,497.40	$175.27	$3,132.47
LFORM - 1.2(18)	0	79	0.22	$0.00	$3,543.09	$0.00	$1,057.27
SHIP'S FILL	12	20	0.27	$669.31	$1,092.04	$142.65	$265.52
EODMU	3	7	0.32	$195.71	$456.65	$35.19	$93.68
MISSION ALLOW.	49	71	0.27	$2,708.08	$3,896.99	$577.19	$947.53
Total Pallets/Costs	79	411		$4,243.14	$19,486.16	$930.31	$5,496.47

Material Type	# of Pallets Dbl Hndl (SB)	# of Pallets Dbl Hndl(Flbk)	Dbl Hnd-Trv Seal Beach	Dbl Hnd-Trv Fallbrook	Dbl Hnd-Ld Seal Beach	Dbl Hnd-Ld Fallbrook	Sched Cost Comm Trk (SB)	Load Convey at Seal Beach	Tvl Intrastation Costs (SB)	Trvl Interstation (SB to Fallbrk)
LFORM	1	82	$109.09	$1,522.52	$156.93	$3,116.11	$68.26	$273.90	$97.96	$682.61
LFORM - 1.2(18)	0	28	$0.00	$513.88	$0.00	$1,051.75	$0.00	$0.00	$0.00	$0.00
SHIP'S FILL	1	7	$88.79	$129.06	$127.73	$264.14	$55.56	$222.93	$79.73	$555.59
EODMU	0	2	$21.91	$45.53	$31.51	$93.19	$13.71	$55.00	$19.67	$137.07
MISSION ALLOW.	3	25	$359.24	$460.54	$516.81	$942.58	$224.79	$901.99	$322.61	$2,247.94
Total Pallets/Costs	5	144	$579.02	$2,671.54	$832.99	$5,467.77	$362.32	$1,453.81	$519.97	$3,623.20

Material Type	# of Pallets Comm Trk	# of Pallets P.W. Trucks	# of Pallets B.Mtrs Trucks	Offload Conv Comm Trk	Trvl & Setup Comm Trk	Load Convey for Pad	Trvl & Setup for Pad	Tvl Intrastation (Public Works)	Tvl Intrastation (Base Motors)	Offload Conv at Pad
LFORM	15	104	145	$147.13	$105.40	$2,449.00	$1,603.46	$818.72	$4,041.18	$4,356.77
LFORM - 1.2(18)	0	33	46	$0.00	$0.00	$776.99	$508.73	$259.75	$1,351.76	$1,382.27
SHIP'S FILL	12	13	19	$119.75	$85.79	$314.73	$206.07	$105.22	$608.21	$559.91
EODMU	3	4	6	$29.54	$21.16	$98.35	$64.40	$32.88	$260.17	$174.97
MISSION ALLOW.	49	50	70	$484.52	$347.09	$1,180.24	$772.75	$394.56	$2,000.38	$2,099.65
Total Pallets/Costs	79	204	286	$780.94	$559.44	$4,819.31	$3,155.41	$1,611.13	$8,261.70	$8,573.57

Material Type	Personnel Spt (Fallbrk)	Helo Spt Team (Military)	Helo Ops Costs	***Total Cost for Operation***
LFORM	$7,261.29	$1,751.60	$71,490.12	***$114,527.24***
LFORM - 1.2(18)	$2,303.78	$555.73	$22,681.61	***$35,986.61***
SHIP'S FILL	$933.18	$225.11	$9,187.49	***$16,038.49***
EODMU	$291.62	$70.35	$2,871.09	***$5,113.35***
MISSION ALLOW.	$3,499.42	$844.14	$34,453.07	***$60,182.12***
Total Pallets/Costs	$14,289.29	$3,446.92	$140,683.37	***$231,847.80***

Model Assumptions for Vertrep Offload Operation

Description	Low	Static Amt	High
Stabilized Rate			
Stabilized RSS&I Rate per Workhr		$101.93	
Sched Cost for Comm Truck		$75.00	
Average Cost for Comm Truck		$750.00	
Base Motors (CamPen) Trk Cost per Hr		$11.91	
Base Motors Truck Cost per Mile		$0.31	
Helicopter Operations Cost per Hr		$1,500.00	
Helo Support Team Cost (Military)		$13.66	
Tons per Pallet		0.67	
Lifts per Ton (Onload)		0.8522	
Lifts per Ton (Offload)		0.8925	
Crew Size			
Crew Size Load/Unload Truck		2	
Crew Size w/ block & brace (Fallbrk)		3	
Crew Size Station Truck (Driver)		1	
Crew Size Switch Engine (Seal Bch)		2	
Crew Size (Pad Offload)		3	
Crew Size (Helo Pad)		5	
Helicopter Support Team (Marine/Navy) Personnel		9	
Percent of Pallets			
Double Handling Percent (Seal Beach)	4%	6%	10%
Double Handling Percent (Fallbrook)	20%	35%	50%
Amount of Equipment			
Number of Helicopters		5	
Number of Public Works Trks (Fallbrk)		5	
Number of Base Motors Trks (CamPen)		7	

Description	Low	Static Amt	High
Pallets per Vehicle			
Prep Ave Plts/Mag/Trip (Seal Bch)	6	10	12
Prep Ave Plts/Mag/Trip (Fallbrook)	6	8	12
Double Handling Plts/Trucks (Seal Bch)	2	4	12
Double Handling Pallets/Trks(Fallbrk)	2	10	20
Average Pallets per Comm Trk (SB)	3	20	26
Ave Plts per Station/Base Motors Truck	8	20	26
Time per Action			
Days of Evolution (Helo)	2.5	3	3.5
Std Work Hours per Evolution Day	9	9	10
Hrs for Base Motors - Prestage		4	
Trips to Pad per Day	2	2	2.5
Time per Pallet			
Travel & Setup Time Hrs (Seal Beach)	.2	.4	1.0
Travel & Setup Time Hrs (Fallbrook)	.2	.5	1.0
Dbl Hndlg Trvl Time Hrs (Seal Beach)	.18	.2	.22
Dbl Hndlg Trvl Time Hrs (Fallbrook)	.23	.25	.28
Loadtime Double Handling (both)	.04	.05	.06
Loadtime w/ Block & Brace (Fallbrook)	.05	.06	.07
Loadtime Station Trk	.04	.05	.06
Loadtime to Segregation	.04	.06	.75
Miles to Pad (Round Trip)	46	46	60

Description	Low	Static Amt	High
Offload Time (Station Truck)	.04	.05	.06
Offload Time (Initial Receiving)	.12	.17	.25
Hrs per Trip Intra-station (Fallbrook)	.45	.50	.55
Hrs per Trip Intra-station (Seg to Mag)	.15	.25	.40
Hrs per Trip Truck to Pad (Round trip)	1.08	1.12	2.00
Hrs per Ton - for Segregation		5.50	
Other Station Personnel Support Hours		27.00	
Helicopter Operation Hrs per Helo		20	

OFFLOAD VERTICAL REPLENISHMENT OPERATION - FALLBROOK (LHA)

TRIANGULAR DISTRIBUTION MODEL

Average Load - LHA

	Total Pallets	Percent from SB	# of Pallets From SB	# of Pallets From Fallbrk	# of Total Tonnage	# of Total Helo Lifts
LFORM	249	6%	15	234	166.83	142
LFORM - 1.2(18)	79	0%	0	79	52.93	45
SHIP'S FILL	32	38%	12	20	21.44	18
EODMU	10	30%	3	7	6.7	6
MISSION ALLOW.	120	41%	49	71	80.4	69
Total Pallets/Costs	490		79	411	328.30	280

Model Costs - Ave Load (LHA)

Material Type	# of Pallets P.W. Trucks	# of Pallets B.Mtrs Trucks	Personnel Spt (Fallbrk)	Helo Spt Team (Military)	Helo Ops Costs	Tvl Intrastation (Public Works)	Tvl Intrastation (Base Motors)
LFORM	104	145	$7,228.19	$1,743.62	$74,527.15	$827.18	$4,025.92
LFORM - 1.2(18)	33	46	$2,293.28	$553.20	$23,645.16	$262.44	$1,346.78
SHIP'S FILL	13	19	$928.92	$224.08	$9,577.79	$106.30	$606.08
EODMU	4	6	$290.29	$70.02	$2,993.06	$33.22	$259.37
MISSION ALLOW.	50	70	$3,483.46	$840.30	$35,916.70	$398.64	$1,992.93
Total Pallets/Costs	204	286	$14,224.15	$3,431.21	$146,659.86	$1,627.78	$8,231.09

Material Type	Percent to Segregation	# of Pallets to Segregation	Onload Conv for Segregation	Trvl & Setup for Segregation	Transfer to Segregation	Receipt at Segregation	Segregate	Onload Conv at Segregation
LFORM	3%	7	$634.13	$48.07	$21.12	$273.89	$2,805.82	$73.51
LFORM - 1.2(18)	3%	2	$201.19	$15.25	$6.70	$86.90	$890.20	$23.32
SHIP'S FILL	98%	31	$2,662.17	$201.78	$88.67	$1,149.81	$11,779.19	$308.59
EODMU	20%	2	$169.78	$12.87	$5.66	$73.33	$751.22	$19.68
MISSION ALLOW.	98%	118	$9,983.13	$756.69	$332.52	$4,311.79	$44,171.98	$1,157.21
Total Pallets/Costs		161	$13,650.40	$1,034.66	$454.67	$5,895.71	$60,398.42	$1,582.31

Material Type	Percent Direct to Magazine	# of Pallets from Pad to Magazine	Onload Convey for Magazine	Trvl & Setup for Magazine	Receipt at Mag from Pad	Transfer from Seg to Mag	Trvl & Setup Seg to Mag	Receipt at Mag from Seg
LFORM	97%	242	$4,430.65	$1,554.11	$8,855.67	$11.26	$48.07	$73.72
LFORM - 1.2(18)	97%	77	$1,405.71	$493.07	$2,809.63	$3.57	$15.25	$23.39
SHIP'S FILL	2%	1	$11.74	$4.12	$23.47	$47.27	$201.78	$309.47
EODMU	80%	8	$146.75	$51.48	$293.32	$3.01	$12.87	$19.74
MISSION ALLOW.	2%	2	$44.03	$15.44	$88.00	$177.25	$756.69	$1,160.52
Total Pallets/Costs		329	$6,038.88	$2,118.22	$12,070.08	$242.36	$1,034.66	$1,586.83

Material Type	***Total Cost for Operation***
LFORM	***$107,182.06***
LFORM - 1.2(18)	***$34,075.04***
SHIP'S FILL	***$28,231.24***
EODMU	***$5,205.67***
MISSION ALLOW.	***$105,587.26***
Total Pallets/Costs	***$280,281.27***

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